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Oklahoma Gypsum Deposits and Industry

By L. C. Snider*

The gypsum deposits of Oklahoma occur in the western part of the state. The entire area may be divided as follows: (1) The first line of gypsum hills; (2) the second line of gypsum hills; (3) the southwestern area. These subdivisions are shown on the accompanying map (Fig. 3). The rocks of the entire region are the Permian redbeds.

The first line of gypsum hills enters the state from Kansas on the south side of the Salt Fork of the Arkansas River and, swinging back on the northeast side of the Cimarron, crosses it just north of the Kansas line and then follows down the southwest side of that stream as far as the vicinity of El Reno, where it dies out. From Fairview to El Reno the hills drop back from the Cimarron until they are nearer to the North Canadian, but they continue to face the Cimarron. The line crosses parts of Woods, Harper, Woodward, Major, Blaine, Kingfisher and Canadian Counties.

Throughout this district there are usually three beds of gypsum, which vary considerably from place to place in thickness, character and the distance by which they are separated. They are interstratified with extremely soft red and green shales and red sandstones. Each ledge is underlain by greenish dolomitic sandstone which varies in thickness from one or two inches to three feet or a little more. In spite of the very soft character of the gypsums, they are much more resistant than the sands and shales with which they are associated, and consequently form the cap of the escarpment and of the numerous buttes and outliers which occur along the range.

In the northwestern part of the area from the Kansas line to Fairview, the gypsum beds are each 10 ft. or more in thickness and are separated by only a few feet of shale. The gypsum is made up of crystals of selenite which lie in all directions, and which reach a size of two inches or more in length. The weathered surface of this selenitic gypsum presents a mosaic appearance on account of the etching out of the crystal boundaries by solution. The effects of solution are also shown by the great number of sink holes, caves and gypsum springs with which the region abounds. Fig. 1 shows the general appearance of the hills in this region.

Southwest from Fairview the beds change from the selenitic form to a dense fine-grained structure, and at the same time become somewhat thinner, while the intervening shales become thicker. In the middle one of the three ledges there is a bed of anhydrite which varies in thickness from a few inches to four or five feet. Locally anhydrite is not a continuous bed, but occurs as boulders or lentils. In this region the hills are even more pronounced than to the northwest, the exposures of gypsum are sharper and the effects of solution much less evident. This type of development is best shown in the northern part of Blaine County. Here the anhydrite in the middle gypsum is at its greatest thickness, forming a conspicuous white band at or near the top of the hills and breaking off in large rectangular blocks. Southeast from Watonga the gypsums thin rapidly and the hills decrease; the gypsums become lenticular and the three ledges lose their identity and finally disappear a few miles north of El Reno.

The second line of gypsum hills occupies a large area, principally in Dewey, Custer, Washita and Caddo Coun-

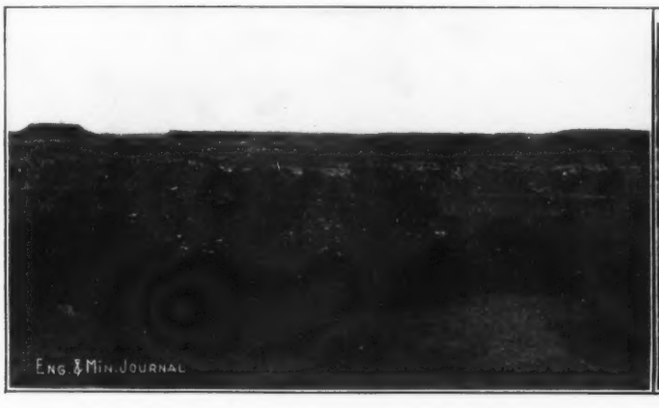

Fig. 1. Gypsum Hills in Northern Blaine County

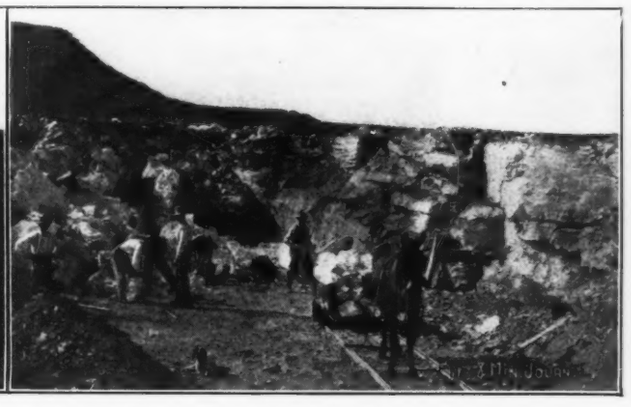

Fig. 2. Quarry, American Cement Plaster Co., North of Watonga

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ties. The stratigraphy of the redbeds is very irregular in this region, and the gypsum beds are lenticular, are not continuous over large areas and vary greatly in thickness. A gypsum ledge may grade into gypsiferous sandstone within the distance of a few rods. In the northern part of the area there is only one gypsum ledge of any importance, but in the southern part near Weatherford, in southeastern Custer County, and in eastern Washita County, as many as four or five ledges may show on a hillside and single ledges 65 ft. in thickness at the outcrops have been measured. Ledges over 100 ft. thick have been reported in borings. The character of the gypsum also varies considerably, changes from fine-grained, massive gypsum to coarsely crystalline selenite, and from pure white to red or green colors showing in a single ledge within short distances.

Southwestern Area Probably Continues Second Line of Hills

The southwestern area is, in all probability, a continuation of the second line of hills, but no connection can be made out on account of the sand and alluvium of the North Fork of the Red River. This area occupies all of Harmon, southeastern Beckham and western Greer and Jackson Counties. The gypsums resemble those of the second line of hills. They are, however, more regular in their stratification and five ledges usually show distinctly. The best exposures of these gypsums in Oklahoma occur along the Salt Fork of the Elm River. Five ledges are well shown in this region and two of these are rather thick, reaching 20 ft. as a maximum.

Gypsite or gypsum earth is used at the majority of the Oklahoma mills, either alone or in connection with rock gypsum. This material is found usually in the valleys of the small streams in the gypsum regions, but does not seem to have been washed down from the hills. It is apparently formed by the water from gypsum springs or that which works down the slopes. This water is gypsiferous and when it evaporates from the soil in the valleys, the gypsum is left in the soil.

The deposits of gypsite vary in size from a few square feet to those covering 400 acres. The thickness of the deposits also varies considerably, 12 to 15 ft. being the maximum. Workable beds of gypsite are known in Blaine, Custer, Washita, Grady, Stephens, Caddo, Jackson and Harmon Counties.

Calcination in Kettles Is General Practice

The manufacture of gypsum products is very simple. The rock gypsum is quarried from the outcrop, broken into pieces easily handled by one man and is hauled to the mill or to the loading switch in wagons or in dump cars on a track. A typical quarry is shown in Fig. 2. The gypsite is scooped up in drag scoops and loaded into wagons or cars through a trap or hauled directly to the mill in wheeled scrapers.

The gypsite is ready for the kettles without further preparation, but the rock gypsum must be crushed and ground. To effect this, the rock is passed through large jaw crushers, and then through "crackers," resembling large coffee mills, which reduce it to pieces less than one inch in diameter. This "gravel" is reduced to a fine powder in buhr mills, from which it is elevated into bins above the kettles.

The calcining kettles are cylindrical and are built of steel 3/8 in. thick. The ordinary sizes are 8 or 10 ft. in diameter and 8 ft. in depth. A vertical rod, passing down through the center of the kettle and driven by a cog wheel at the top, is provided with arms which stir the gypsum during calcination. About 25 hp. is required to drive the shaft of a 10-ft. kettle. Two or four flues about one foot in diameter pass through the kettle horizontally. The object of these is to secure a better distribution of the heat. The kettles are set like a boiler above a grate and surround by a wall about two feet thick built of firebrick on the inside and common brick on the outside.

A 10-ft. kettle with four flues has a capacity of about 14 tons of plaster. The gypsite or ground rock is fed slowly into the kettles, one to two hours being required

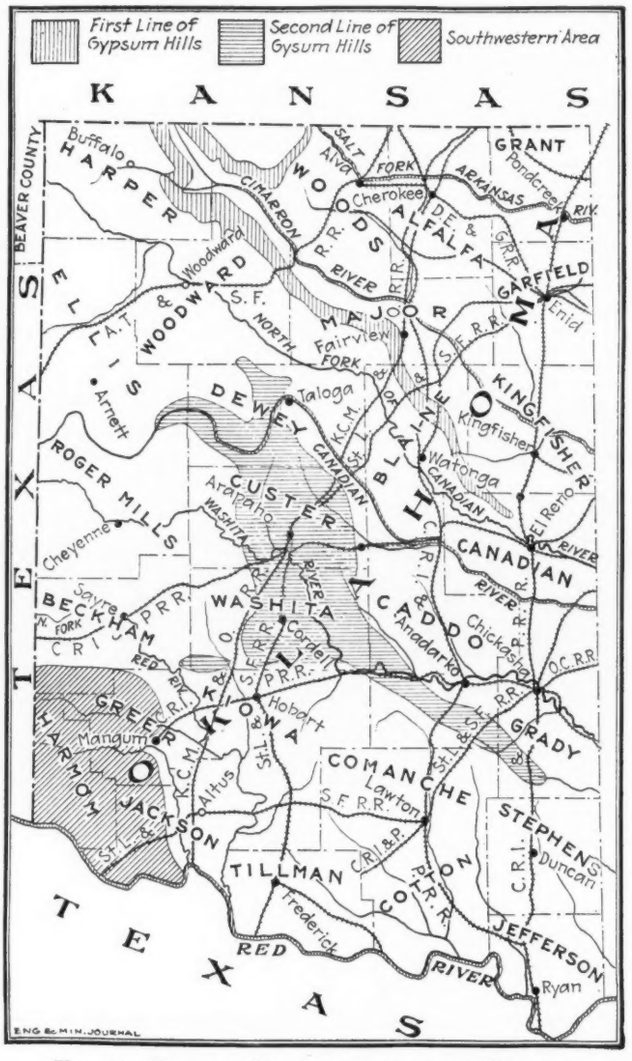

Fig. 3. Map of Oklahoma Gypsum Regions

to fill a 14-ton kettle, depending on the condition of the material. While being filled the kettle is kept at a temperature of about 212° F. In about one hour after filling the kettle reaches a temperature of 230° F. and the mass begins to "boil," owing to the expulsion of the water of crystallization. At about 10° higher the mass settles down solid, but at 270° begins to boil violently again. At about 350° a gate near the bottom of the kettle is opened and the calcined gypsum flows rapidly into the "hot pit," which is built of fireproof material.

From this pit the material is elevated and screened

through bolting cloth or fine wire-screens. The portion passing through the screens is conveyed to bins above the mixers, while the coarse material is reground. Retarder and hair or wool fiber are added in the bins, and the whole passed down through the mixer, which feeds the plaster through openings at the bottom into sacks holding 100 lb. each.

Cummer Continuous Process in One Plant

In one mill, at Wilson, the Cummer continuous calcining process is used. In this process a rotary kiln is used in place of the kettles. The rock is crushed to ¾-in. ring and stored in a bin over the feed spout of the rotary kiln. A mechanical feeder regularly feeds the crushed rock into the kiln. About 10 min. is required for the material to pass through the kiln and during its passage it reaches a temperature of 400 to 500° F. It is then fed into large bins built of brick, or of wood lined with brick, and allowed to remain 24 hr., during which time the excess heat carried over from the calciner is equally distributed through the material, which is thus uniformly calcined. The calcined gravel is then ground in buhr mills, screened and mixed as in the kettle process. This process is based on the fact that heat in excess of that required for calcination, when applied in the presence of moisture, does not result in "dead burned" plaster. The gravel is steaming during its stay in the kiln and still contains moisture when placed in the bins. The advantages claimed for

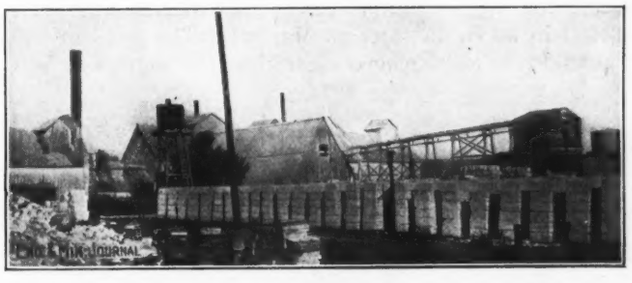

Fig. 4. Block Storage Yard, American Cement Plaster Co.

the process are two, the saving of fuel for calcination due to the continuous process, and the saving in power, since the rotary calciner is said to require less power than kettles of equal capacity, and much less power is required for grinding the calcined material from the bins than for grinding the raw gypsum as it comes from the quarry.

It is claimed that 70 lb. of good coal is required to calcine one ton of plaster in the rotary kiln, while 150 to 200 lb. per ton is required in the kettles. The power necessary for a rotary calciner of 200 tons capacity per 24 hr. is said to be 12 hp., while three 8-ft. kettles, of somewhat less capacity, require 40 hp. or more for at least a portion of the time. The one mill in Oklahoma using this process has been in operation only a short time and the plaster has not yet been thoroughly tried out on the market. However, it is reported to be of good quality, and that made by the process in the East is said to be satisfactory.

Costs Vary Greatly

The cost of building and equipping a plaster mill will vary greatly with the type of mill and local conditions. A modern fireproof mill with three 10-ft. kettles can be built and equipped for from $65,000 to $70,000. The cost of manufacturing plaster also varies widely with local conditions, price of fuel, nature of material and kind of product. In one Oklahoma mill, where the conditions may be considered about average, the cost per ton for one month was $2.17 per ton of white (rock gypsum) plaster, and $2.01 for the dark plaster (40% gypsite). For another month the average cost per ton of the white material was $2.80 and of the dark, $2.57. The relative cost of the different operations of manufacture may be stated as follows, for one of the two months mentioned above: Quarrying rock, $0.4515 per ton of rock; hauling rock, $0.2047 per ton of rock; gypsite, $0.0873 per ton of raw material; retarder and fiber, $0.2668 per ton of plaster; fuel for power and calcining, $0.312 per ton of plaster; milling (labor, lubricants, repairs, sundries), $1.0956 per ton of plaster. These costs are subject to wide variation, yet the figures given will furnish an approximate idea of the costs of manufacture with the kettle process. Data on the cost of manufacture by the rotary-calciner process are not available.

At present there are 12 plaster mills in Oklahoma. Over half of these are in northern Blaine County, where the gypsums of the first line of hills are well developed and where the railway facilities are good. The mills in this county are those of the American Cement Plaster Co., at Watonga, the Monarch Plaster Co., at Watonga, the Southwestern Plaster Co., at Okeene, the Oklahoma Gypsum Co., at Wilson, the United States Gypsum Co., at Southard, the Roman Nose Gypsum Co., at Bickford, and the Rubey Stucco-Plaster Co., at Ferguson. The other mills on the first line of hills are those of the Oklahoma Plaster Co., at Alva, which uses rock quarried at Quinlan, and of the U. S. Gypsum Co., southwest of Okarche. The only mill in the second line of hills is at Bush Springs, in Grady County, where the Acme Cement Plaster Co. has a new steel and concrete mill, the only fireproof mill in the state. Mills belonging to the same company at Marlow and Cement have burned in the last few years. In the southwestern area the only mill is that of the U. S. Gypsum Co., at Eldorado, in Jackson County. The last two mills use gypsite exclusively, while the others use rock gypsum or the rock and gypsite together. One mill is situated at McAlester, in the center of the coal fields.

Variety of Products Sold

Very little gypsum is sold for land plaster in Oklahoma. Between 8000 and 10,000 tons are sold annually to portland-cement mills. The great bulk of the production is calcined and sold as some form of plaster. The list of plasters made in the mills of the state include dental plaster, molding plaster or plaster of paris, unfibered wall plaster, hair-fibered wall plaster and wood-fibered wall plaster. Only one mill has attempted the manufacture of Keene's cement and that only in a small way. In the last few years, the making of partition block has become an important branch of the gypsum industry. The U. S. Gypsum Co.'s plant, at Okarche, the American Cement Plaster Co.'s plant, at Watonga (Fig. 4), and the Roman Rose Gypsum Co., at Bickford, manufacture considerable quantites of the block. The last named company is installing a new plant for block manufacture. Its process is continuous and the blocks are made over collapsible metal cores. The value of the annual production of gypsum and its products in Oklahoma has varied from $300,000 to $450,000 for the last few years.

North Star Annual Report

The annual report of the North Star Mines Co. for the calendar year of 1912 gives the gross production of the North Star mine as $1,038,372; expenses incurred were $501,154 for operation; $57,738 for development; $41,534 for Cincinnati Hill expenses; interest and dividends amounted to $37,200, resulting in total net earnings for the year of $475,146. Dividends of $300,000, equivalent to 12% on the capital stock, were paid. This production was wholly from the North Star mine, between the 2700- and the 4000-ft. levels. There was delivered to the mill 106,494 tons of rock, which was hand sorted, so as to leave 101,181 tons for crushing. The average yield of this rock was $10.263 per ton crushed; deducting costs of $5.524, leaves a realized profit of $4.739 per ton crushed over all costs of operation and development. The value per ton decreased 48c., and the cost about 31c. from the figures for 1911. Of the mill production 77.45% was obtained by amalgamation and 22.55% by cyanidation, including the concentrates cyanided. The tailings averaged 26c. per ton, about 2½% of the total contained value.

Development work of 4601 ft. was done in the North Star mine, and enough ore was disclosed on the 5000- and 5300-ft. levels to about balance the extraction for the year. Such a qualitative expression of ore reserves is all that is possible in this case, as those familiar with the irregular orebody will understand.

Work was discontinued on the Cincinnati Hill mine after the beginning of August, 2088 ft. of development work having been done in 1912 up to that time. One small pocket of ore yielded 656 tons, worth $3652. The result of Cincinnati Hill exploration has been disappointing, and the total expenditure, $91,355, has been written off as a loss. Among miscellaneous transactions for the year are included $6859 expended on improvement account, chiefly for additional power equipment, $5966 for property purchased, $2000 advanced to the Middle Yuba Hydro-electric Power Co., and the heavy expenses involved in the Champion development and purchases.

The showings on the Champion at Nevada City are so encouraging as to lead the directors to authorize completion of the purchase before the date of expiration of the option, July 2, 1913. Development work, especially on the Ural and Merrifield veins, has disclosed fairly promising blocks of ore. Expenditures on the property for 1912 total $214,633, including the $13,694 paid on account of purchase price. Twenty stamps of the old Champion mill were repaired and operated largely as a test, giving a production of $30,350. Further improvement of the mill will include a cyanide plant.

A general rearrangement of the system of accounting, necessary, in order to obtain the allowances for depreciation in calculating the net income subject to the excise tax, is described as follows:

The cost price of the mining property as at Jan. 1, 1909, when the excise-tax law went into effect, was taken as $1,778,245, which, distributed among 1,039,871 tons of ore, the amount estimated to have been contained in the mine at the beginning of this company's operations in 1899, gives a cost rate of $1.71 per ton. The application of this rate for the period up to Jan. 1, 1909, on the 464,871 tons of ore then milled, reduced the cost value of the mining property to $983,316; while the continuation of the same principle through the years 1909, 1910, 1911 and 1912, according to the tonnage milled, has reduced the cost value of the original property to $336,420, on which depreciation will continue at the established rate of $1.71 per ton until the balance of cost price is extinguished. In making this adjustment of the original cost of the property as at Jan. 1, 1909, the company has also written up the value of the property as at that date, to the extent of $1,136,684 to represent with the remaining cost value a fair estimate of the salable value of the mineral contents at Jan. 1, 1909, according to data furnished by the company's engineers. The total amount charged against property account therefore on Jan. 1, 1909, was $2,120,000, which has been reduced by subsequent allowances for depreciation as above stated, to the sum of $1,473,104. The company has been inclined to hold that the additional value written up to property account representing "unearned increment" accrued before the excise tax went into effect should also be subject to an allowance for depreciation; but the present ruling of the Treasury Department is not favorable to this view.

The financial report includes a combined statement of the present North Star Mines Co. with its predecessor, showing the financial results of the North Star enterprise. It appears that at all the properties operated, there were mined 1,035,194 tons, worth $13.568 per ton, giving a total of $14,045,092. Deducting operating and development expenses there is left a profit of $5,037,888, subject to a deduction of $1,691,976 for improvements and purchases, and there have been paid dividends to the extent of $3,786,989, truly an ancient and honorable record.

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Overturning of La Grange Dredge, Calif.

La Grange dredge, of 5-cu.ft. bucket capacity, on Tuolumne River, Stanislaus County, Calif., was overturned in 30 ft. of water on Mar. 21. The accident was caused by a leak made by striking the starboard bow

OVERTURNED DREDGE AT LA GRANGE, CALIF.

against a point of rock. The boat settled against the bank of the flotation pond in about 4½ hr. after the leak was discovered. Preparations for righting were begun on the following day. The flotation pond was cut off by the construction of a dam thrown up by scrapers hauled by a donkey engine, and the water lowered to 28 ft. with electric pumps. The stacking ladder was damaged, but other parts and machinery appeared to remain intact. The accompanying photograph shows the position of the boat after it had settled at an angle of about 40°. It was expected to have the dredge in operation again by the end of April.

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Invar Tapes Were Used for the Cincinnati Topographic Survey, borrowed for the purpose from the United States Coast and Geodetic Survey, according to Hugh T. Mitchell ("Eng. News," Apr. 3, 1913). Such tapes have a coefficient of expansion of 0.0000004 per deg. C. as compared with 0.000011 for steel tapes.

Aluminum Precipitation at Nipissing

By E. M. Hamilton*

SYNOPSIS—A statement of the reasons leading to the adoption of aluminum dust instead of zinc for precipitation, and description of the process as installed. The combination of zinc and arsenic in solution interfered seriously with extraction and aluminum removed the difficulty. The latter forms no cyanogen compounds and allows a regeneration of cyanide during precipitation. The result of its use is an economy over the zinc-dust method.

It is hardly necessary to begin this article with a description of the material being treated because the composition of the ores of the Cobalt district has been dealt with by other writers at various times, but before proceeding to the subject of aluminum precipitation at the mill of the Nipissing Mining Co., it may be interesting to explain the circumstances that led up to its adoption.

In the course of preliminary experiments on the ore to find out the conditions of extraction of the silver by cyanide, it was noticed that the solutions, after being precipitated with zinc and used again, rapidly lost their dissolving efficiency. This phenomenon is not uncommon, but I have never before seen an instance where the deterioration was so marked.

At first I thought the trouble might be due to gradual accumulation of reducing agents in solution, because when tested with permanganate, as suggested by Clennell, it displayed considerable reducing power. I do not, however, consider that reducing power, as indicated in this way, is necessarily any criterion of the dissolving efficiency of a solution, because substances may react by the permanganate method as reducers, though they may not have power to abstract oxygen from the solution (e.g., KCNS) and if they do not absorb the dissolved oxygen from the solution, they cannot be classed as reducing agents in the sense of being detrimental to extraction on that account. Still, I thought it a point for careful investigation in this case, and tried aëration of the solution even to an exaggerated extent, and also the addition of hydrogen peroxide and oxidation by electrolysis, but all without effect in improving the dissolving power of the solution. It was then obvious that the trouble was to be looked for elsewhere.

Zinc Fouled the Solution

The first thing to come under suspicion was the presence of zinc, seeing that a fresh solution that did not contain zinc gave a good extraction, whereas the same solution after the zinc precipitation gave a bad one, and after a second precipitation, a worse one. By way of following up this suggestion, three extraction tests were made under similar conditions on a sample assaying about 30 oz. of silver per ton. *A* was treated with precipitated stock solution, with the analysis shown in Table 1.

B was treated with new solution and *C* with stock solution as in Table 1, but after most of the zinc had been precipitated by sodium sulphide. The ore was ground to pass a 200-mesh screen, and 48 hr. agitation was given with a solution of 0.2% free cyanide.

*Nipissing Mining Co., Cobalt, Ont.

The residues assayed, *A*, 6.55 oz. Ag; *B*, 2.31 oz. Ag; and *C*, 3.70 oz. Ag. This result pointed to the zinc as being the offender, and following this indication, two tests were made on another sample of ore, one being treated with a plain freshly made cyanide solution, and the other with a solution (also freshly made), to which 0.1% of zinc had been added. The residues after 48 hr. were: *D*, 4.28 oz. and *E*, 8.19 oz. per ton.

TABLE 1. ANALYSIS OF SOLUTION USED IN TEST

KCN (free)	0.09%
Alkali (protective), in terms of NaOH	0.13%
Ag, per ton of solution	0.80 oz.
Zn	0.113%
KCNS	0.069%
Sb	0.0025%
Cu	0.021%
As	0.021%
Fe	0.007%

It was not at all apparent why the zinc should act in this way, because as a rule I have found that the presence of zinc in solution has no appreciable effect on extraction. On looking through the list of substances in the foregoing analysis, the antimony and arsenic suggested themselves as being the most unusual, and since the amount of the latter was 10 times that of the former, the arsenic was selected as being a possible conspirator.

Arsenic Also a Hostile Influence

Another series of experiments was thereupon made in which *F* was treated with new solutions; *G* with new solution to which 0.021% arsenic was added; *H* with new solution to which 0.1% zinc was added, and *I* with new solution to which 0.021% arsenic and 0.1% zinc were added. Upon assaying, the residues ran: *F*, 3.22 oz. Ag; *G*, 4.90 oz.; *H*, 4.78 oz., and on *I*, 7.05 oz. silver per ton.

All these results seemed to point to the fact that the degeneration of the working solutions was due to the use of zinc as a precipitant in the presence of arsenic, and accordingly some other method of precipitation was sought. There was a possible choice of at least three other methods: electrolysis, sodium sulphide and aluminum.

As I have had long experience with electrolytic precipitation of cyanide solutions, and am well aware of its weak points, it was considered to be a remedy of last resort, though a possible one. Sodium sulphide would be a very suitable precipitant for silver solutions, except for two drawbacks. The first is that complete precipitation is not obtained without using an excess of the reagent, which would then have to be removed by a lead compound, the alternative being a tailing solution too high in silver to form an effective residue wash. The second drawback is the recovery of the silver as a sulphide instead of in the metallic state. Attention was therefore turned to aluminum.

Aluminum Precipitation Suggested by Moldenhauer

As far back as 1893, Carl Moldenhauer patented the use of aluminum as a precipitant for gold and silver from cyanide solutions. He says in his specification: "Zinc has heretofore been employed in practice by pref-

erence in precipitating gold from the cyanide solutions obtained by leaching auriferous ores. The employment of zinc for this purpose is found, however, to be attended with serious disadvantages. Now, I have discovered that aluminum can be employed for this purpose in place of zinc without the disadvantages attending the use of the latter. While zinc forms a combination with the bound or free compound of cyanogen and alkali contained in the cyanide solution, aluminum separates the gold very quickly from the cyanogen solution without entering into combination with the cyanogen, but simply reacting with the caustic alkali which is present at the same time. By the action of aluminum, the cyanide of potassium employed for leaching the gold out of its ore is regenerated, which is not the case when zinc is employed. But the zinc does not confine itself to entering into combination with the cyanogen of the cyanogen compounds of the gold, but also acts upon the free cyanide of potassium contained in the solution, so that a great part of the latter is consumed, but this is not the case when aluminum is employed. These results are of the greatest importance when the solution separated from the gold is to be employed in subsequent gold-extracting operations, as the whole of the cyanogen in the regenerated and liberated cyanide of potassium is enabled to renew its action, but the lyes resulting from the employment of zinc cannot be employed with the same advantage in subsequent operations for the extraction of the gold.

"Numerous attempts have been made to regenerate the zinc, but are found to be inconvenient and costly. It is consequently evident that an important saving in cyanide of potassium is obtained by the employment of aluminum."

Aluminum Forms No Cyanogen Compound

The inventor does not appear to have developed the idea on a practical scale, but it is worthy of more attention than it has received, because, as he points out, owing to the fact that aluminum does not form any compound with cyanogen, not only is the whole of the cyanide recovered which was combined with the precious metals, but also the additional loss of cyanide by direct combination with the zinc is avoided. In the case of solutions strong in cyanide, the latter loss may be considerable.

Some may dispute the ground I take when I count as lost the cyanide that remains combined with zinc, because it is often stated that the double cyanide of zinc and potassium is almost as efficient for dissolving purposes as the simple cyanide. My experience is, however (at any rate in the case of silver ores), that the reading obtained by the use of KI indicator with excess of caustic, is worthless as a measure of the dissolving power of a cyanide solution, the efficiency being for practical purposes proportional to the "free" cyanide reading obtained by stopping at the first faint opalescence without the use of KI indicator.

Caustic Alkali Necessary

The fact that aluminum does not replace the precious metals in the cyanogen compound, renders necessary the presence of a caustic alkali, the reaction probably occurring theoretically thus:

$$6\ NaAgCy_2 + 6\ NaOH + Al = 6\ Ag + 12\ NaCy + 2\ Al(OH)_3,$$

the aluminum hydroxide at once dissolving in the excess of caustic to form sodium aluminate,

$$2\ Al(OH)_3 + 2\ NaOH = Na_2Al_2O_4 + 4\ H_2O.$$

If this explanation be the correct one, it should be possible to make one part of aluminum precipitate 12 times its weight of silver, but in practice I have so far not been able to reach this proportion. Perhaps in the case of low-grade solution, when caustic and aluminum are both present in excess, as must usually happen in practice, the following may more nearly represent what actually goes on:

$$2\ NaAgCy_2 + 4\ NaOH + 2\ Al = 4\ NaCy + 2\ Ag + Na_2Al_2O_4 + 4\ H.$$

In this case, one part of aluminum would precipitate four times its weight of silver, and this figure approaches more closely the actual proportion I have found in practice, which is about three of silver to one of aluminum. For zinc precipitation Clennell gives the following equation:

$$NaAgCy_2 + 2\ NaCy + Zn + H_2O = Na_2ZnCy_4 + Ag + H + NaOH;$$

and according to this, one part of zinc will precipitate only 1.7 times its weight of silver. This zinc reaction is also worthy of comparison with that of aluminum from the fact that two molecules of free cyanide appear to be used up in addition to the two molecules of cyanogen in combination with the silver.

The consumption of cyanide by direct combination with the zinc is illustrated by Clennell as follows:

$$Zn + 4\ KCy + 2\ H_2O = K_2ZnCy_4 + 2\ KOH + H_2.$$

The indications then would go to show that quite apart from any detrimental action that zinc may have upon extraction of the precious metal from its ore, the substitution of aluminum should be, on its own merits, a valuable improvement, and I shall try to show later on that this proposition is borne out in practice.

Aluminum Successfully Used at Deloro, Ontario

Although it is 20 years since Moldenhauer so ably explained the advantages of aluminum over zinc, the commercial application of the process is almost unknown. In 1893, H. Forbes Julian experimented with it (cf. Julian and Smart, "Cyaniding Gold and Silver Ores"), but does not seem to have met with any practical success. He first used vertical aluminum plates set ¾ in. apart in a standard precipitating box, but, owing probably to lack of surface, the result was unsatisfactory. Afterwards he used shavings, which showed a great improvement, but in time the metallic surfaces became coated with alumina, which impeded precipitation to a prohibitive extent. He was unable to overcome the difficulty, and finally abandoned the attempt to make use of the process.

The first instance I have been able to find of its successful commercial application, was at the Deloro smeltery, Ontario, where it was introduced by Prof. Kirkpatrick for dealing with a rich cyanide liquor resulting from the treatment of some special products. Warned, probably by Julian's failure, and having before his mind the wide use of zinc dust, he conceived the idea of applying the aluminum in the form of a powder, by which means he overcame the obstacles encountered by Julian, and made the process a perfect success.

In 1910, Kirkpatrick took out a patent for a special

tank designed to effect a proper mixture of the dust with the solution. The difficulty in the use of aluminum dust is to get it to sink, because it is not easily wetted, and even when wet, tends to rise to the surface of liquid through the buoyancy imparted by minute hydrogen bubbles, unless a violent agitation is maintained. Kirkpatrick overcomes this trouble by using a tank having a vertical shaft at its center, carrying one or more screw propellers, which, when revolved by a suitable power connection, forms a vortex in the center of the solution to be precipitated.

A sufficient quantity of the dust is then added, and as it spreads out on the surface, the vortex sucks it down to the bottom, whence it passes outward towards the periphery and up again to the surface, again to be sucked down at the center. This motion is maintained until precipitation is complete, when the whole charge is pumped to a filter press for the separation of the precious metal. The same process has been in use at the O'Brien mill in Cobalt for three years or more in precipitating the working solutions in the cyanide plant and has apparently given entire satisfaction.

Rate of Precipitation Depends on Violence of Agitation

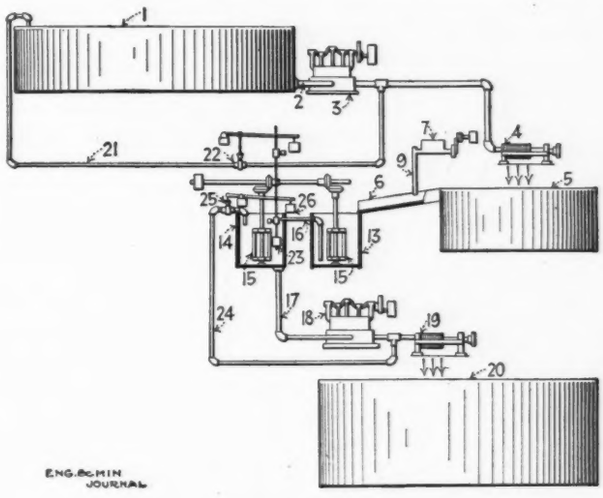
Before finally adopting aluminum as the precipitant for the mill, a series of laboratory tests were made, which showed that not only was the combined cyanide liberated, as indicated by titration, but also that no deterioration of the solvent power of the solution was apparent after using and precipitating a number of times.

The above mentioned tests showed, among other things, that the rapidity of precipitation depended to a large extent on the violence of the agitation used for mixing and that whereas a charge shaken up briskly in a bottle would have its reaction completed in about two minutes, a large charge stirred up in a tub with a stick needed from 10 to 15 min., other conditions being equal. It, therefore, seemed that it should be possible to get away from the intermittent system represented by the Kirkpatrick method and work more on the lines of the continuous zinc-dust precipitation. The appliances for the latter process, making use of the Merrill machinery, had already been installed, including clarifying press, dust feeder, emulsifier and two triangular presses. It was evident, however, before making a start, that more time for contact would be required than had been provided for the zinc dust by the 200 ft. of pipe line between the emulsifier and the press. It was also evident that it would be difficult to feed the aluminum dust, even as an emulsion, into a stand-pipe connected with the pump suction, because, as already explained, the dust is difficult to wet, and even after it has been wetted, it will soon tend to rise to the surface and float as a thick scum unless a brisk agitation is maintained. If it were fed into a stand-pipe it would collect on the surface of the liquor and gradually fill the pipe instead of being drawn down into the current flowing to the pump. Therefore, the following modification of zinc-dust practice was adopted and was found to answer admirably.

Modified Zinc-Dust Apparatus Used for Aluminum

Referring to the accompanying illustration, 1 is the pregnant solution storage tank, from which the solution passes to a triplex pump and thence to the clarifying press 4. The tank 5 is now superfluous, having been installed as a storage for the zinc-dust process, but the clarified solution falls into it as previously arranged, flowing out again at once by the launder 6 into tank 13. The feeder 7 for the aluminum dust, which discharges directly into the stream of solution, flowing in the launder 6. The emulsifier supplied for zinc dust has been eliminated as not serving any useful purpose in the present process. The launder is fitted with a cover and has a flap of canvas hanging over the discharge opening to avoid loss in dusting. Tanks 13 and 14 are about 6 ft. deep by 5 ft. in diameter, and have a central revolving shaft to which are bolted vertical planks extending from the bottom to the surface of the liquor contained therein. These comparatively narrow vertical strips when revolved at about 60 r.p.m., form an efficient agitator for mixing the emulsion and render unnecessary the propellers with their vortex effect described by Kirkpatrick.

It will be noticed that tank 13 is always full and that the emulsion has to pass down to the bottom and up the 6-in. connecting pipe in order to reach tank 14 and



Arrangement for Aluminum Precipitation, Using the Apparatus Designed for Zinc-Dust Precipitation with Modifications

to avoid any tendency for heavy silver precipitate to accumulate in the bottom of tank 13, the revolving shaft has a pair of long arms or paddles about 3 in. wide, bolted on just above the bottom to keep such heavy particles in suspension, until they can be sucked by the current up the vertical pipe into the next tank 14. This latter tank may be considered chiefly as a pump feeder from which the emulsion passes to the triplex pump 18, and thence to the precipitate press.

Constant Level Automatically Maintained

In order to maintain a constant level in tank 14 and avoid overflows on the one hand and the entrance of air into the pump suction on the other, a system of automatic control valves operated by a float, is used. It will be seen on examining the sketch that each pump is provided with a bypass, 21 and 24, and both these are operated by a single float shown at 23 in the drawing.

The valve 25, which is usually more or less open, is operated by a long lever which is hinged in such a way that it can be bent upwards from the hinge point, but not downwards, and is normally held in a straight line by the weight 26. The vertical rod passes freely through a slot in the lever and carries a tappet in such a position as to engage the lever at a certain height. When it is desired to increase the flow to the precipitate press, the float will rise in the tank until the tappet engages the lever, thus gradually closing the bypass valve 25 and throwing more work onto the pump. The flow may thus be increased until valve 25 is completely closed, this point representing the full capacity of the pump 18. If then, the flow into the tank be further increased, the float will continue to rise and the lever will flex at the hinge, thus causing the upper tappet to engage the lever on valve 22 and by opening the same, allow the surplus solution to flow back to tank 1, whence it came. With this device, it is perfectly simple to get any desired flow of solution up to the full capacity of pump 18, maintaining practically the same level in the pump-supply tank. The total time consumed between the point where the precipitant is added and the point where the emulsion enters the press, is from 10 to 15 min. on the average, and precipitation is normally completed in this period.

Aluminum-Dust Feed Regulated by Solution Test

The feed of dust is regulated from time to time by taking a sample of the effluent from the press and adding a little strong sodium sulphide solution to it. If the faintest coloration appears (due to the formation of silver sulphide), the feed is increased little by little until the test indicates complete precipitation. The effluent is tested in this way every hour or so and a fine adjustment of the feed is thus obtained.

It has already been stated that caustic alkali is necessary for this reaction, and therefore caustic soda is added to the pulp before cyanide treatment in sufficient quantity to bring the solution up to from 2 to 3 lb. NaOH per ton. In connection with the alkalinity of solutions, there is an important point to be noted. Lime must be reduced to the smallest quantity necessary for slime settlement, because it tends to form with the dissolved aluminum an insoluble calcium aluminate, which collects in the precipitate press, giving a low-grade product and one almost impossible to melt by the usual methods. It is, therefore, necessary, when contemplating the introduction of this process, to ascertain whether the slime will settle readily in a solution high in caustic and low in lime and also whether the use of caustic interferes in any way with the efficiency of the solution for extraction. I may say that neither of these points has so far given any trouble at the Nipissing mill.

Precipitation Results Good

At the time of writing, this process has been in use about four months, so the data available should be fairly reliable. The figures for the first three months of 1913 are here given just as they stand in the official records and include the "bad days" as well as the good ones.

TABLE 2. PRECIPITATION RESULTS

Month	Head Assay, oz.	Tail Assay oz.	Precipitation, %
Jan.	8.23	0.23	97.2
Feb.	8.56	0.21	97.5
Mar.	8.50	0.15	98.2

These figures do not represent the full efficiency of which the process is capable, because a few bad assays due to mistakes and oversights, which are unavoidable in starting a new mill, have spoiled the averages. Usually the daily assay stands at about 0.05 oz. silver in the tails, and with ordinary care there is no reason why it should ever run over that figure.

TABLE 3. CONSUMPTION OF ALUMINUM

Month	Aluminum, Lb.	Silver Precipitated oz.	Aluminum Used per oz. of Silver, lb.
Jan.	2926	141237	0.02
Feb.	2742	143141	0.019
Mar.	3014	142604	0.021

For comparing these figures with those for zinc dust, it is not easy to obtain representative data on the latter owing to the custom of publishing such figures in terms per ton of ore instead of per fine oz. of precious metal. I have, however, come across the following table in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for December, 1909, which may be of some assistance.

TABLE 4. CONSUMPTION OF ZINC DUST PER OUNCE BULLION

Oz. Au+Ag. per ton Solution	Ratio Au : Ag	Lb. Zinc Dust Consumed per oz. Au+Ag Precipitated	Remarks
0.02	2 : 2	6.60	Homestake low solution
0.15	2.2 : 1	0.91	Homestake weak solution
0.47	1 : 4	0.59	Cerro Prieto
0.49	1 : 4	0.57	Cerro Prieto
0.70	1 : 4	0.42	Cerro Prieto
1.84	1 : 19	0.19	Montana, W. J. Sharwood
3.29	1 : 99	0.16	An American mill

It is impossible to say what the zinc-dust consumption would have been at the Nipissing low-grade mill, because it was never tried there, aluminum having been used from the start. Table 4 shows, however, that the figure varies enormously with varying conditions and that, as far as the series is carried, the higher the metal content of the solution, the less the zinc dust consumption per ounce, so presumably the consumption on Nipissing solution would have been lower than the lowest in the series. On the other hand, the strength of cyanide in the solution, 0.2%, would tend towards a high zinc consumption by direct combination. All things considered, a consumption of about 0.1 lb. zinc per oz. of silver would probably not be far out as an estimate for comparison with the actual aluminum consumption shown.

TABLE 5. REGENERATION OF CYANIDE, AVERAGE OF DAILY TITRATIONS

Month	Titration % KCN		Gain after Precipitation	
	Head	Tail	Per Cent.	Lb. KCN per ton of solution
Jan.	0.196	0.228	0.032	0.64
Feb.	0.181	0.215	0.034	0.68
Mar.	0.179	0.215	0.036	0.72

The regeneration shown above approximates closely the actual amount of cyanide combined with silver in a solution assaying 8.5 oz. per ton. It must not be forgotten, moreover, that the cyanide shown to be actually recovered does not represent the total saving effected, because, as already pointed out, there is in the case of zinc precipitation a loss of cyanide by direct reaction with the zinc.

Before we appreciated the deleterious effect on this process of lime in the working solutions, the precipitate presses contained a good deal more calcium aluminate than silver, the latter being sometimes as low as 10%. At present the precipitate assays under normal working conditions, between 25,000 and 27,000 oz. per ton, or from 85% to 92% silver. This product may be

melted in crucibles without any flux, yielding bullion about 990 fine. At the Nipissing, it is briquetted with a little soda and borax and melted direct in the oil-fired reverberatory, already described in the JOURNAL,[1] producing bullion over 997 fine.

ULTIMATE COST OF ALUMINUM LESS THAN ZINC-DUST METHOD

The present price of aluminum dust laid down at the Nipissing, including freight and duty (15% *ad valorem*), is from 35 to 39c. per lb., and of zinc dust 7c. per lb. Taking the consumption of the two reagents at the figures already given, 0.02 lb. per oz. of silver for the first, and 0.1 lb. for the second, the ore yielding 20 oz. of silver per ton would show as in table 6.

TABLE 6. COMPARATIVE COST OF ZINC AND ALUMINUM METHODS

Aluminum Dust		Zinc Dust	
0.4 lb. aluminum at 38c.	$0.152	2 lb. at 7c.	$0.14
Caustic soda, 1.5 lb. at 2¼c.	0.033		
Per ton	$0.185	Per ton	$0.14

In the figure for caustic soda, 0.5 lb. has been allowed for chemical consumption and 1 lb. for mechanical loss.

To offset the extra charge of 4½c. per ton of ore, there would be a direct recovery of 1.6 lb. of cyanide, at 15c. or $0.24 per ton; a further saving in cyanide, varying in amount with varying conditions, due to the absence of any action between the precipitant and the cyanide, a saving in the cost of melting and refining and in some cases, in marketing the bullion. In the case of ores, which on a commercial scale fail to yield the extraction predicted by laboratory work on account of fouling of working solutions, a gain in extraction is obtained which may often amount to 7%, and which in the case of some of the Nipissing ores was as high as 14 per cent.

ALUMINUM GRANULATIONS SUGGESTED TO REPLACE DUST

As an alternative to the use of the dust, Charles Butters, consulting metallurgist for the Nipissing Mining Co., has suggested the use of aluminum granulations placed in a revolving tube mill through which the solution to be precipitated is continuously passed, the attrition produced thereby serving to scour the metal surfaces and thus obviate the principal obstacle encountered by Julian in his experiments. Tests are now being made of this method, the chief advantage of which, if it should be a success, would lie in the reduced cost of precipitant, the price of granulations being only about 24c. per lb. as against 35 to 40c. per lb. for dust.

In conclusion, I wish to acknowledge the valuable assistance of J. J. Denny, resident metallurgical chemist, in carrying out the various experiments and the facilities afforded by James Johnston, constructing engineer, for putting into practice the ideas conceived: also, to express my appreciation of the action of R. B. Watson, general manager, in permitting me to publish the official data included in this article.

The Handling of Iron Ore and Coal Through the Same Shaft was described by George S. Rice, speaking before the New York Section of the American Institute of Mining Engineers. This is done at a Belgium colliery where faulting has brought some beds of iron ore to approximately the same level with the coal measures.

[1]Dec. 7, 1912.

Mining Investments*

It has been urged that money employed in mining should be allowed a high rate of interest because of the extraordinary uncertainties of the business. While I do not wish to dismiss this contention cavalierly, it seems to me that about all there is to say on this point is that a valuation is logical only on the assumption that the factors used in making it are correct. If such factors are judiciously taken, they are as likely to err on one side as on the other—as likely to exceed as to fall short, consequently there is no need of counting on any further doubts than such as are inherent in all human enterprises. I have generally assumed that 5% was a normal interest or discount rate. If that is so, it is a fair figure to use in a mine-valuation, which should be nothing but a candid inquiry into the present value of expected profits.

MERITS OF MINING PROPERTIES

At the risk of repeating some commonplaces, I venture to add that mining property has some exceedingly good points—for reasons so obvious that they are often lost sight of. In the nearly perpetual battle against absolute fakers, and those other fakers in a highly respectable garb who exploit the public by inducing gross over-valuations of the shares of good mines, it is quite possible for conservative mining engineers to lay too much stress on the dangers and uncertainties of mining. These uncertainties lie very largely, almost wholly, in that stage of the business which is only preliminary; the prospecting stage, the search for a starting point. When that stage is passed, mining changes its character completely and instead of being one of the most hazardous, it becomes one of the least hazardous of businesses. It is true that this applies only to developed ore with an assured market, and that the business of getting out ores already discovered is often mixed with venturing money to find new deposits; but it is quite easy to exaggerate the uncertainty of finding ore. Not infrequently, reserves are measured by mere conventions which take no real measure of the amounts which can be safely relied upon. Furthermore, if ore is developed for from 10 to 15 years ahead, which is frequent among iron mines, the question of opening up more ore is not a question of prime financial importance. Take Lake Superior for a capital example. Every mining man in that field knows that enough ore has been developed to maintain the present output for 30 or 40 years. It surely is more to the point to calculate what these supplies are worth than to be worrying about ores yet to be found. A great deal of money and a great deal of intelligence are expended each year in exploring new ground, but it is absurd to say that the business is hazardous because it is wise to make such expenditures. The fact is that such properties are highly favored.

In the first place, they are indestructible. This advantage is too obvious to talk about. In the next place, these properties get their value from nature as well as from man; that is, they are partly independent of management. A Colorado operator once remarked that he had no use for a mine that would not stand bad management. There is truth in this dictum and every mining man knows what he means. A mine's profit may be blighted by lax administration; it may be made ridiculous by improper finance-

*Excerpts from J. R. Finlay's paper, "The Valuation of Iron Mines," Bull. A. I. M. E., March, 1913.

ing, but if the mine is good it will make money with the most ordinary management. Its success does not depend wholly on the extraordinary talents of its owner. Commercial, financial, manufacturing or transportation enterprises, on the other hand, may depend absolutely upon the ability of some one man. When that man dies or weakens the whole structure may go straight to the scrap heap and the business may never earn a dollar.

Not so with a great orebody. It will be more valuable with the genius to exploit it, but it will pay good dividends for plain John Smith or Will Jones. To take a good example, I will venture to say that the average mining man feels far more confidence in the United States Steel Corporation as a mining concern than as a manufacturing concern. At any rate, he feels that it is infinitely more stable and secure with its mines than it would be without them; that its mines are an asset guaranteed by nature itself.

If we approach the subject of mine valuation without careful analysis of what we are talking about, it is easy to confuse the risks of the business of prospecting with those of mining. In the first case, there is no question of valuation. It is simply a question of spending money to find a mine and develop it if found. If the venture is successful the adventurer will get a large return, usually 20 or 30% a year in the case of Lake Superior mines, on the money actually embarked. His risk is that he will find no ore. He may try many times without finding it. Everybody knows that; and commercial practice makes the reward of success high. But when a man successfully finds a mine, develops it and makes it pay, he has a valuable property. It then becomes one of the surest of assets. It would then be absurd to value it as if it were still a prospector's vision. If one did that, the mine would be worth no more found than unfound. Quite the contrary, I think; the established mine is worth more than it seems to be worth. The owner is fully assured not only of what he has found, but generally that he can find more.

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Nevada Hills Mining Co.

The third annual report of the Nevada Hills Mining Co. covers a period of nine months ended Dec. 31, 1912. Arrangements were made at the last meeting of the stockholders to have the fiscal year of the company terminate with the calendar year. At the end of March, 1912, the company was indebted in the sum of $495,000, whereas, at the end of the year the sum amounted to only $100,000 with available assets showing a surplus of about $31,000. The net realization was $438,909 for the last nine months of the year.

The mine is situated about 45 miles from a railroad, and this should be borne in mind in considering the per-ton costs of production. In the nine months, 8 tons of ore worth $816 per ton was shipped and 29,976 tons of ore averaging $26.63 per ton was milled. The average grade of the total, 29,984 tons of ore produced, was $26.84 per ton, of which $2.60 was represented by loss in tailings, leaving the net production, $24.24 per ton, or a total of $726,664. The cost of production was $9.60 per ton, leaving an operating profit of $14.64 per ton, from which $4 for depreciation was deducted, leaving a net profit of $10.64 per ton. The figures making up the cost of production are: Stoping, $1.76; development, $2.07; a total of $3.83 for mining; moving dump ore, 12c. per ton; milling, $3.07; marketing, $1.03, general expense, 71c.; interest, 63c.; bullion tax, 21c.; property tax, 4c.; current construction amounted to 11c.; and miscellaneous earnings amounted to 15c. The total operating profit for the period was $438,909, from which $120,000 depreciation was deducted, leaving a net profit for the year of $318,909.

The plant underwent several minor changes which brought its capacity up to 140 tons per day. The addition of agitation equipment enabled giving the ore longer treatment with cyanide solution, and the recovery was brought up to 90.2%, or 1.4% greater than the previous years. The cost of milling was reduced about $1.81 per ton from the figure of the year before. In the crushing department a sorting-plant equipment was added which will make possible the elimination of between 5% and 10% waste, from the mine-run ore.

The total development work amounted to 5866 ft., costing $10.56 per ft. Interesting items of cost are, for drifting and crosscutting, $9.77 per ft.; raising, $12.50 per ft.; winzing, $30.03 per ft. About 20% of the total advance was made in ore, producing 3372 tons of an average value of $21.17 per ton. A second electric mine locomotive was built in the shops of the company and installed at a cost of $947. It was demonstrated in the previous year that electric-motor haulage effected a saving of about 10c. per ton over hand tramming. The average tram of the ore underground is 1500 ft. No statements of additions to ore reserves are made in the report.

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Utah Consolidated Annual Report

The report of the Utah Consolidated Mining Co., covering the calendar year of 1912, shows a total of 183,386 dry tons of ore mined and shipped to the International Smelting & Refining Co., at International, Utah. These shipments included 159,143 tons of copper ore, averaging 2.146% copper, 0.077 oz. gold, 0.828 oz. silver; and 23,716 tons of first-class lead ore, averaging 19.974% lead; 0.073 oz. gold; 4.189 oz. silver; 0.820% copper; and 530 tons of lead concentrates, averaging 21.872% lead; 0.143 oz. gold; 5.432 oz. silver; 0.729% copper. The total product of the shipment was 6,506,814 lb. copper; 8,734,398 lb. lead; 230,004 oz. silver; 14,042 oz. gold.

The ore remaining in sight is given as 251,500 tons of copper ore, averaging 1.9% copper; 0.04 oz. gold and 0.58 oz. silver, together with 24,100 tons of first-class lead ore, averaging 14.96% lead; 0.055 oz. gold; 3.51 oz. silver and 0.97% copper. In addition there are 12,000 tons of low-grade lead ore, which will require concentration. The tonnage of ore reserves has been maintained, but the average value has decreased. Labor troubles seriously interfered with operations during the year, and for three weeks the mine was completely shut down.

The profit and loss account shows receipts from sales, after making allowances for variation in stock on hand, of $1,626,729; increased by sundry receipts to $1,677,919. Expenses amounted to $1,073,996, covering mining, development, smelting, transportation, office expenses and minor items. Dividends of $450,000 were paid during the year.

Searching for Oreshoots in Veins

SYNOPSIS—A discussion of the value of geologic theories as guides in exploration. The geologists should restrict their efforts to general guidance leaving the application in individual cases to the operator. Insufficient credit given to the man in charge of operations as opposed to the occasional visitor. Hypotheses must be followed and they should be based on as sound theory as possible. Detailed sampling of indications is the greatest help to intelligent exploration.

In recent years novel types of orebodies have been recognized and described, and considerable light has been thrown on the physical and chemical conditions attending the deposition of ores. Once an orebody has been accidentally discovered and sufficiently exposed, geologists of different schools hasten to label it and to formulate hypotheses, from their varying standpoints, as to its origin. By comparison of their conflicting views we can usually select by elimination a certain residuum of generally accepted theory, which to the educated miner appeals as furnishing at least a reasonable and probable explanation of the facts as they appear to him. But it remains true that these deductions are as yet useful only in a general way. They serve to explain tentatively the origin of a metalliferous deposit as a whole; but seldom throw much light on what, to him, are questions of more immediate economic importance and more immediately absorbing interest. What are the reasons for the localization of the valuable portions of the deposit; and where are such valuable portions to be looked for? It is emphatically true that when the generalizations of economic geology are translated into the vernacular of concrete experience they commonly fail; that when the geologist is sufficiently imprudent to tell us where to look for ore he proves wrong just as often as the rest of us; and his failures are the more striking, because his deductions are often more positively expressed than those to which we, who walk warily in the light of mere experience, have learned to confine ourselves.

Theories Finally Discredited Usually Leave a Residuum of Truth

The recent experience of Butte, of Tonopah, or to come nearer home, of Leadville, reminds us how imperfect are the observations, and how fallible the practical deductions, of the most competent and careful geologists. Yet, while the concrete predictions as to the immediate future of Butte, based on the rediscovered and reinforced theory of secondary enrichment, have been discredited by the course of development, and while we now see that the theory is less universally applicable than we all at first supposed, the theory itself stands. The science of economic geology advances in bounds only to overreach itself and fall back; but it never recedes quite to the starting place. In each of the fashionable theories which from time to time spring up, there is a kernel of solid truth, which remains as a permanent addition to the stock of human knowledge, after the husks have been blown away by the searching blast of criticism.

Field of the Geologist Is Limited

How is the geologist to furnish a complete explanation of the facts before the facts themselves have been laid bare? On reflection we should admit that no final and convincing description of any mining district can ever be written except as an obituary. The object of such work is to arrive at general truths which may ultimately be applied elsewhere; and in our hurry for something which the geologist cannot supply, reliable deductions as to the nature and form of orebodies that the miner has not yet found, we rush him into furnishing descriptions of phenomena which we cannot recognize when we look for them, and hazarding opinions which too often prove unfounded. Yet the fault is not so much his as ours, who expect the impossible. The result is to confuse the popular mind; to discredit Science herself, instead of the fallacies and half truths which are delivered in the name of science.

We must learn to ask at once less and more of the geologist. In new and partly opened districts, he can give us a useful and indeed essential aid—a study of the structural geology. He can read for us the relative ages of veins and rock formations; can assist us by collecting and correlating the data, much of which is unknown to or overlooked by the technical man who is most familiar with any given district; and can inform us what is known of ore occurrences elsewhere where the conditions are sufficiently simliar to suggest possible analogies in the deposits which result from the conditions. The less he ventures into the realm of concrete prediction, the better for his own peace of mind, and for the progressive unfolding of correct scientific conceptions.

Operators Themselves Should Apply Theories to Local Conditions

This groundwork or outline furnished, it remains for the miner to fill in the details. It is here that the role of intelligent hypothesis, based on sound scientific conceptions, and on detailed observations drawn from practice in comparable localities, comes in. There are only two ways of conducting mining exploration. The one is essentially empirical, prospecting by shafts and levels at regular distances on a plan adopted with a view to subsequent convenience in working; or by boreholes spaced at more or less regular intervals. This method, in its multitudinous ramifications, is eminently suitable for regular veins or simple deposits. But just as we must be prepared in metallurgy to deal with increasingly complex and difficult ores, the simpler ones having been already taken care of by our predecessors, so in mining, the future belongs to the man who can find and extract the more irregular deposits; who can unravel the puzzling and intricate cases of complex faulting, and of devious ore-channels. The mere mechanical problems incident to mining are so much child's play compared with these, and I cannot but think that eventually the honor, and remuneration, attending professional work will in greater measure be regulated by its difficulties, and the quality of the fac-

Note—Reprinted in part from an address delivered by George E. Collins as retiring president of the Colorado Scientific Society and published in the "Proceedings" of the society, April, 1913.

ulties which are necessary to cope with and overcome them.

Hypotheses Necessary for Guiding Exploration

But to return from this digression. In the development of irregular orebodies, we must either adopt the same geometrical basis of exploration, which soon leads to bankruptcy, or else direct our exploration according to some working hypothesis. To "follow your ore" is an excellent maxim, when you have it; but it does not help much when your ore is yet to be found. Hitherto, the work of hunting for ore has been left as a rule to the so called "practical man." He also plans his work along the lines suggested by some hypothesis. The trouble is that, as has been pointed out by others, there is no theorist so wild or so inveterate as your "practical man"; none that rides his hobbies so hard or so far. What is needed is the trained mind, acquainted with the literature of ore deposits in various districts; able to observe from day to day all the facts that suggest similar conditions and possibly parallel results in his own, and familiar with all the various theories of ore deposition which are applicable to those conditions. Thus equipped, he is able to form rational hypotheses on which to base exploration, and to realize when the time has come to discard them and adopt others. In other words, the scientific miner of the future will proceed along much the same inductive lines as those which have laid the foundations and built the superstructure of all modern scientific progress; the only difference being that he cannot artificially create the conditions of each experiment, for which reason his progress must inevitably be far slower.

The detailed study of ore deposits, with reference to their origin and distribution, requires four qualifications: (1) A thorough grasp of the fundamentals of physics and chemistry; (2) a wide first-hand acquaintance with other occurrences elsewhere, for the purpose of comparison; (3) a close and continuous study of the deposits under consideration, for the reason that much of the evidence bearing on the genesis of the deposit is removed as rapidly as it is exposed; (4) most important of all, imagination, by which alone the mind can conceive tentative hypotheses of origin, to be tested by the observed facts.

Man on the Job Has Best Opportunity for Study

In an examination of a deposit we can merely see what happens to be exposed in drifts, raises and so forth, at that particular moment. Even of these, only a small proportion in most mines is open for examination at any one time; and the openings themselves form only part of the total area. The visiting geologist or engineer therefore sees only a small fraction of the entire deposit, and it is natural enough that in many cases the really significant piece of evidence escapes him. The man who has the best opportunity to study the deposit is he who is familiar with it throughout the entire period when it is being worked; who ses the freshly broken face of each drift, and the developments from day to day in every working place. A relatively less degree of ability so applied may be expected to yield greater results than an occasional brief visit from an eminent scientific authority. The greatest progress in the study of ore deposits may be looked for when these men become conversant with the fundamentals of economic geology; when the mine superintendent and the mine surveyor have been trained in the methods of the field geologist, to observe accurately and to record their observations.

Even now I do not believe for one moment that the men who do the actual work of underground mining are as unobservant or as incapable as one might suppose, judging from the comparative absence of mention of their observations in the modern literature of ore deposits, and especially in the publications of the U. S. Geological Survey. I prefer to conjecture that their work has somehow failed to become adequately recognized in the publications; and that many of the luminous observations recorded are really due to the careful study of some unnamed foreman or mine superintendent who conducted the distinguished visitor through the mine. It would also seem as if there is some convention in the Survey which forbids its members to refer to the observations or acknowledge the assistance of any but their own colleagues, past or present.

In the future science dealing with the origin of ore deposits, and particularly the localization of their richer portions, I believe that the work of the chronicler will be of equal dignity and importance with that of the official historian. I go further, and express the opinion that when more of our economic geologists take up the actual work of directing and planning underground mining operations, their opportunities for original observation will be improved, and the results will be careers of increased usefulness and increased scientific progress.

Old Cornish Rules Not Universally Applicable

The Cornish miners early appreciated most of the practical generalizations which have since been developed, such as the favorable influence of junctions, especially junctions with veins of the same age; the tendency for rich parts to occur opposite one another in parallel veins; that for workable orebodies to occur in those portions of a lode which are inclosed in country rock of moderate hardness and general suitability as to fracturing and permeability; the pitch within the lodes of orebodies in stratified country in conformity with the line of intersection with the strata, etc. One rule which they enumerated, however, I wish to mention specially, because it does not correspond with my own experience, viz.: that those portions of a lode which most nearly approach the vertical are the most productive. This was explained by Moissenet and by Henwood as being due to the fact that the descent of the hanging-wall of a vein with a somewhat zigzag section would naturally contract the flatter parts and widen the steeper parts. This is reasonable enough, applied to Cornwall, where the faulting in the productive veins is nearly always normal. Most of the individual experience, however, which has colored my own conceptions of vein phenomena has been in the western United States, where reverse faulting in veins is common, and where the complete filling with ore of a large open fissure in stratified country having a zigzag fracture, has not happened to form part of it. In my own observation, local flattenings of dip have been favorable places for ore, due perhaps to the opportunities such places present for the retardation of mineral solutions, and consequently the production of ore either by deposition in a fissure or by replacement of the country.

This difference in observation, then, leads to the con-

clusion that we have decidedly advanced in our understanding of the subject; for instead of confining ourselves, as did Thomas and Tregaskis in Cornwall, to observations of a large number of cases, and deducing therefrom a general law which fails because the cases observed by them were confined to a single district, we have learned to inquire the reason for each phenomenon which comes under our notice. In fact we have been compelled to reason; for mere comparison shows at once that observations are often mutually contradictory.

"Oreshoot" an Unfortunate Term

In a discussion in *Economic Geology*, Vols. 3 and 4, which was initiated by Professor Irving, he draws what seems to me a useful distinction between what he calls "shoots of occurrence," thereby meaning occurrences of ore along a fissure which is completely barren of ore or gangue in its intervening portions, and "shoots of variation," which consist of high-grade areas inclosed in or separated by lode material of lower grade. Lindgren objects to this distinction because it is not universally applicable; but I do not see that this fact lessens its practical utility. The names proposed by Irving appear to me clumsy; but the tagging with appropriate names is of relatively small importance, so long as the essential distinction between the actual ideas is borne in mind. We need a new general term for use instead of "oreshoots," which to most people suggests one particular form or kind of ore occurrence. Personally, I prefer to speak of an "orebody," which conveys the idea of economic value and limitation in dimension, without suggesting any particular hypothesis of origin or special form.

Individual Failures Should Not Discredit the Use of Theories

There is no royal road to the discovery of orebodies which do not crop out at surface. Yet the study of the subject is not without practical utility. It enables us to substitute intelligent underground prospecting for purely geometrical or empirical prospecting. Our orebodies are not found as a rule where we look for them the first time or the second; for, as Lindgren says, the shoots "often fail to materialize where in accordance with supposition they should do so." But as the result of a great deal of hard-earned experience I do not hesitate to assert that prospecting based on intelligent hypothesis succeeds far oftener than prospecting which is blind or based on unintelligent hypothesis. Further, the trained engineer familiar with what is known already of the causes of the localization of ore, and its occurrence under widely different conditions in many districts, has a great advantage in finding ore over the ordinary uneducated tributer.

Gold in Ore Is in the Nature of an Impurity

It has frequently occurred to me that, in discussing the origin of ore localizations containing the precious metals and also compounds of the base metals, there has been some confusion of thought owing to failure to distinguish sufficiently between the causes which produced enrichments of gold and those which produced orebodies of the base metals. The same causes which produced the one by no means necessarily produced the other. In the case of the base metals, we are dealing with appreciable quantities which can be expressed in percentages; and their ores, if sufficiently plentiful to be considered ores at all, are at once visible. With the precious metals, on the other hand, and gold in particular, we have to deal with minute proportions, $^1/_{240}$ of 1% being a high-grade ore, quantities which, except for the relatively simple metallurgy of gold, could not be detected, much less worked. It is probable that other rare elements exist in common ores to at least an equal extent, the presence of which, owing to the absence of equally effective methods of assay, is never suspected. The gold in most ores, in fact, may from the standpoint of the chemist or the physicist be regarded as an insignificant and accidental impurity in the very orebodies which derive their economic value from its presence.

Theories of Deposition Change on Longer Acquaintance

The geologist who studies this subject has usually no personal knowledge or equipment for investigating at first-hand this most important factor in the distribution of the ore. He is dependent on the engineer or mine superintendent for information of this kind, which all engineers know is most difficult to ascertain precisely, even with close and prolonged study. How frequently it happens that, even after years of familiarity with the ores of a particular mine, with all the assistance afforded by thousands of assays, the engineer still knows little or nothing positive as to the conditions under which his precious metals occur, or the specific minerals with which they are associated. Indeed, we frequently know more, or rather imagine we know more, after the first week, than after the first year. Now, the unfortunate geologist is usually in the same position as we are after the first week: That is, he has absorbed a great many observations which have every merit except that of being in accordance with the facts. He is necessarily dependent on the information he gets from the local operator, and the stream is no purer than its source. It is by no means true that even a man who is extremely familiar with a mine necessarily knows the valuable ore by its appearance. The ores of some mines can be quite accurately graded by a person who is really familiar with them; in other cases this can never be accomplished.

Difficult to Explain Irregular Distribution of Gold

My personal experience leads me to the conclusion that the distribution of gold in veins is characteristically more irregular than that of the base-metal sulphides. The extent to which this is true is sometimes not realized, because of insufficient sampling, and because in actual stoping the ore gets mixed enough to "average up." But in some large veins, like those of San Juan County, gold has a marked tendency to occur in sporadic nests, suggesting some sort of segregating process from the solutions which supposedly deposited the quartz. I am unable to hazard even a hypothetical explanation of this tendency, unless it is in connection with the recent experiments of Hatschek and Simon on the precipitation of gold from silica gels, which suggest the possibility of such a precipitation in a gel taking the form either of layers or irregular segregations. It is difficult to comprehend such irregularities on any supposition of the

gradual deposition from solutions which are trickling slowly or impounded.

Detailed Sampling Greatest Help to Exploration

As an aid to the discovery of oreshoots, nothing is so important as persistent sampling. By that I do not mean the systematic sampling employed to delimit and ascertain the value of orebodies, the methods employed in which have been thoroughly worked out and described for several years past. I mean rather the kind of sampling which is employed—only not nearly so thoroughly as it should be—by the tributer in search of a "pitch." This kind of sampling is directed more to find *where* values are, than *what* they are; it tests every separate stringer, regardless of size, and every novel vein-material, however small in quantity. Its use reminds one of the children's game of "hide and seek," since as soon as you get a good assay you may be "warm," for it proves that solutions of high value have been at work in that vicinity and it is time to hunt for their channels. More and more, experience teaches me that this is the essential factor in prospecting. The mineralization being of the right character, there is always a fair chance of finding some place where its effects have been concentrated sufficiently to create commercial orebodies. On the other hand, I have learned to distrust the veins, however large or well defined, which show no evidence somewhere or other of mineralization by solutions which were capable of depositing a workable grade of ore. Nearly every mining district contains plenty of such, which have every requisite for making good mines except pay ore. There was a time when a fine-appearing vein appealed to me in itself; and I recollect that at one time I used to suppose that in choosing a place to prospect, it was necessary to select "a fine large generous vein," so that if an orebody occurred in it, there would be plenty of space for a large one. I have grown out of all that. Granted the right kind of mineralizing solution and a fissure, however small, the elements are there already. At some point shattering or faulting will have made spaces enough in which to deposit ore; or, if not, the mineralizers can usually eat out their own receptacle.

When I first began to outline my subject for this address, I intended to give some account of the methods, by hypothesis and experiment, or trial and error, as some will disrespectfully prefer to call it, by which I have endeavored to systematize in practice the search for irregular orebodies in fissure veins. Such experiences, of course, include far more cases of failure than of success. Yet I believe this to be the only rational means of searching, and that in the long run its results are far more satisfactory than the ordinary haphazard methods employed.

Iron Industry of Sweden

A preliminary statement of Swedish iron and steel production for the full year is as follows, in metric tons:

	1911	1912	Changes
Pig iron	633,800	701,900	I. 68,100
Converter steel	93,800	107,200	I. 13,400
Openhearth steel	362,700	401,100	I. 38,400
Total steel	456,500	508,300	I. 51,800
Wrought iron	146,700	148,100	I. 1,400

Openhearth steel is gradually superseding wrought iron in Swedish practice. The exports in 1912 included 204,800 tons pig iron; 85,300 tons blooms, billets and other half-finished forms; 190,300 tons finished iron and steel; a total of 480,400 tons, an increase of 62,100 tons over the previous year.

At the close of 1912 there were in operation in Sweden 103 blast furnaces, 216 forges, 17 bessemer converters and 57 openhearth furnaces.

Phelps, Dodge & Co.

The report of Phelps, Dodge & Co. for the year ended Dec. 31, 1912, shows copper deliveries of $192,297,374 lb., an increase of 11,995,409 lb. over 1911, of which 139,759,515 lb. was its own product. The production was 148,678,889 lb. of copper, of which 140,628,798 lb. was from company ore; 1,689,152 oz. of silver, of which 1,104,510 was from conmpany ore; and 27,687 oz. of gold, of which 16,002 was from company ore. The copper ore extracted from the mines was 1,893,244 tons, of which 1,098,528 tons were concentrated, and 794,716 tons smelted. Including ore, concentrates, slag, and cement copper the total smelted was equivalent to 1,051,315 tons, of which 97,574 tons of ore and concentrates were purchased.

In addition 11,626 tons of lead ore were produced at Bisbee and sold, yielding 30,434 lb. of copper, 2,953,685 lb. of lead, 326,962 oz. silver, and 3889 oz. of gold. The mines at Bisbee (Copper Queen company) produced 786,368 dry tons of ore, including the lead ore listed above, which was shipped to El Paso, while 30,164 tons of sulphide ore were sent to Globe. The copper Queen reduction works treated 672,380 tons of Copper Queen ores and precipitates, 59,850 tons of Copper Queen dump slag and cleanings, 9027 tons of lease ores, 124,083 tons of Moctezuma concentrates, and 97,574 tons of custom ore, a total of 962,914 tons, from which 123,876,100 lb. of copper; 1,689,152 oz. of silver; and 27,687 oz. of gold were recovered, contained in 124,915,708 lb. of bullion.

In the Bisbee mines development work amounted to 78,135 ft. during the year. Ore reserves were increased materially, and the exploratory work throws considerable light on the subject of primary ores, which are now known to exist below the level of secondary enrichment in quantities and values of commercial importance. However, prospecting this ground will be going it blind until the habits of these orebodies are better known. Only 14.9 board feet of lumber were used per ton in stoping, against 16.6 ft. in 1911, through mining by cutting and filling without systematic timbering.

In the smelting department 1,095,861 tons of charge were treated, with 12.78% of coke. The ash in the coke accounted for 45,765 tons of slag, or 6.7% of all the slag made. Flue dust recovered amounted to 64,662 tons, or 5.9% of the charge, but the amount dropped from 8.87% in June to 2.72% in December, due to deflecting the converter fume from the blast-furnace dust chambers, and to treating fine in a reverberatory plant which began operating on June 16. Basic converting completely displaced acid, and now the change is being made to the Great Falls type of shell.

The Detroit Copper Mining Co., at Morenci, mined 501,541 tons of concentrating ore; 6191 tons of smelting; and 11,990 tons of siliceous ore, and treated 520,272 tons of ore, producing 24,802,789 lb. of bullion. From 501,928 tons of 3.08% concentrating ore, there

were 70,438 tons of 16.69% concentrates produced. The blast furnaces smelted 160,649 tons of charge, of which 75,784 tons consisted of ore and concentrates, with a consumption of 18,451 tons of coke. The metallurgical recovery is placed at 93.86%. Deep work in the Yankie, and similar exploration in the Arizona Central mine, lead to the belief that ore may be found at greater depth than has heretofore been considered probable.

PHELPS, DODGE & CO.

Balance Sheet as of Dec. 31, 1912

Assets

Cash	$ 3,500,779
Accounts receivable	2,632,771
Sundry mines	237,694
Copper Queen company	27,000,000
Moctezuma company	8,000,000
Detroit company	6,000,000
Stag Cañon company	6,500,000
Burro Mountain company	3,550,000
Phelps Dodge Mercantile Co.	2,000,000
Total	$59,421,244

Liabilities

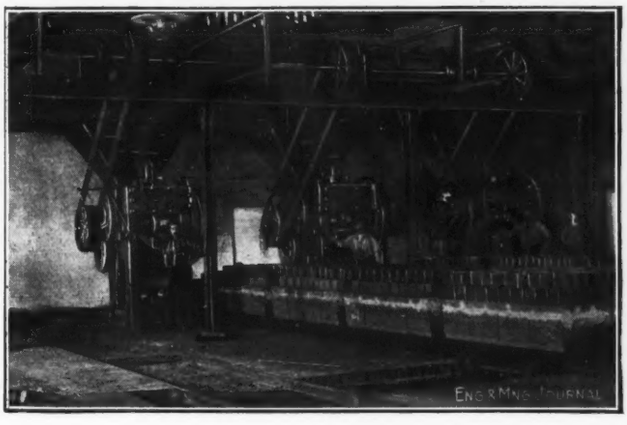
Accounts payable	$5,257,683
Capital stock	45,000,000
Reserve against stocks owned	3,000,000
Surplus	6,163,561
Total	$59,421,244

At the Moctezuma plant, Nacozari, Mexico, 16,206 ft. of development work was done. The most interesting developments were those below the Porvenir tunnel, bearing on the evidence of ore in depth. Ore milled amounted to 596,600 tons of 3.494% Cu, from which 131,062 tons of concentrates were produced, carrying 13.373% of copper. At Leopold, N. M., the Chemung properties were acquired and added to the Burro Mountain property, so that the immediate erection of a concentrator is justified. The Stag Cañon Fuel Co. produced 1,383,562 tons of fuel, of which 646,061 was used to make coke, producing 319,221 tons. The Phelps Dodge Mercantile Co. (controlling all the company stores) made gross sales and transfers amounting to $6,321,411, on which a net profit of 9.21% was made.

A Briquetting Plant in South Wales

At the briquetting plant of the Tharsis Sulphur & Copper Co. at Cardiff, Wales, the Gröndal-Kjellin system is in use. This system involves the use of a straight-line furnace or rectangular tunnel, from 150 to 200 ft. long, at the center of which is the furnace proper, fired preferably by producer gas, although coal or oil may be used. The ends of the tunnel are open except for the trucks which pass through on rails. On each truck is a two-high layer of briquettes to be burned. The view on the right shows the briquettes about to enter the sintering furnace at the Tharsis works at Cardiff. In making the briquettes at this plant no binder is used, as the material contains sufficient moisture to hold together after passing from the presses, which are simple, consisting of a free-falling ram which is lifted by a cam. This is found to exert sufficient pressure by gravity upon the materials to form a briquette, 6x6x3 in. Each press produces briquettes at the rate of 15 per min., and these are placed on the trucks by hand and forwarded to the kilns.

To avoid the effect of the hot gases upon the metal portion of the trucks, the top surface is made of firebrick and the brickwork of one truck abuts that of the next; thus the trucks form a continuous platform of firebrick. To prevent the heated gases from escaping around the sides of the trucks they are built with flanges that dip into sand troughs along the longitudinal walls of the sintering kiln. The trucks enter at the end from which the waste gases of combustion discharge and are gradually moved along by the action of other trucks until they reach the central portion of the tunnel where they encounter the most intense heat of the furnace. Up to this point the briquettes have been subjected to a continually increasing temperature which expels the moisture. At the center of the furnace the temperature may reach 1400 or 1500° C. and the particles are agglutinated to a certain extent. As the trucks pass the furnace proper the incoming air meets the heated briquettes and reaches the furnace in a preheated condition, materially assisting combustion.



BRIQUETTING PRESSES AND SINTERING KILN, THARSIS SULPHUR AND COPPER CO.

Estimation of Sb in Pb-Sb Alloys

According to K. Friedrich (*Metallurgie*, p. 446, 1913), antimony in lead-antimony alloys up to 13%, can be estimated by ascertaining the freezing point of the alloy with a quartz-glass thermometer, and referring to a table of freezing points. [The method would appear useless except for alloys made from pure ingot metals.—EDITOR.]

Gas Pools of Commercial Importance may be present in the region of western Pennsylvania embraced in the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles, according to Bulletin 531-D, of the U. S. Geological Survey. Some gas has been found, although much of the boring has been misguided. There is no reasonable hope for finding oil in commercial quantities in the quadrangles here described.

Mineral Production British of Columbia

The preliminary report of the mineral production of British Columbia, prepared by William Fleet Robinson, provincial mineralogist, and published through his promptness and the coöperation of the Minister of Mines, Sir Richard McBride, earlier than those of any other Canadian province, shows a gratifying increase in the totals for the year. The figures for 1912 are as follows, in comparison with the corrected totals for 1911:

	1911		1912	
	Quantity	Value	Quantity	Value
Gold, placer	.....	$426,000	.....	$500,000
Gold, lode, oz.	228,617	4,725,513	240,000	4,960,800
Total gold	.....	$5,151,513		5,460,800
Silver, oz.	1,802,364	958,293	2,900,000	1,676,200
Lead, lb.	26,872,397	1,069,521	38,000,000	1,520,000
Copper, lb.	36,927,656	4,571,644	51,000,000	8,338,500
Zinc, lb.	2,634,544	129,092	8,500,000	501,500
Total metals	.....	$11,880,063	.....	$17,497,000
Coal, long tons	2,193,962	7,675,717	2,656,000	9,275,000
Coke, long tons	66,005	396,030	264,000	1,584,000
Building materials, etc.	.....	3,547,262	.....	4,250,000
Total	.....	$23,499,072	.....	$32,606,000

There was an increase in every item and the total gain in values in 1912 over 1911 was $9,106,928, or 38.8%. This large increase was, of course, partly due to the higher prices of metals prevailing in 1912; but there was a substantial gain in the quantities of silver, copper, lead, and zinc, as well as of coal and coke.

Metal Production

Practically all the placer gold recovered in the province is obtained in the two northern districts of Cariboo and Cassiar; in the latter, mainly in the Atlin division, although there was some increase last year in the Quesnel and larger operations are expected in the Omineca division. In all these districts, however, the season was unusually short, owing to the light water supply.

In lode gold, the increase came chiefly from the Boundary district, where a comparatively large proportion of the gold is obtained by smelting ores, of which copper is the main metal content. The Granby and the British Columbia Copper companies contributed most of the gold obtained in this way, although the Hedley Gold Mining Co. was a large producer. A fair quantity came also from the Rossland mines. A new producer was added in the Trail Creek division and another one in the Greenwood division.

The production of silver was much larger than for several years, and came in almost equal quantities from the Boundary district and from the Slocan division of the Kootenay. In the Ainsworth division, there were also a number of shippers of silver-bearing ore and a considerable quantity was sent from the East Kootenay. Lead ores, all silver-bearing, showed a good increase in shipments, the Slocan leading, followed in order by East Kootenay, Ainsworth and Nelson. A very large part of the lead ores was treated at the Trail smelting works. The lead bounties paid during 1912 were only about $65,000, the London price of lead during about seven months, having been about where bounty ceases to be payable. According to the existing law, the payment of bounty will cease on June 30 next.

The increase in copper production was large; the Boundary district mines were the largest producers. The Rossland mines contributed only a small quantity, while the Coast district increased its production, which came chiefly from the mines of the Britannia Copper Co., at Howe Sound. Copper now holds the most important position in the metal production of the province.

In zinc production, conditions were not favorable during a large part of the year. The concentrating mill at the Whitewater group, which was destroyed by fire, has not yet been replaced. Transportation facilities have been restored in the Slocan, which made it practicable to resume shipments from the Lucky Jim mine, where the ore is shipped crude. Outside of this, most of the zinc-bearing material was shipped as concentrates made in the form of second products in mills concentrating ores containing lead and silver. The principal shippers were the Standard, the Van Roi, and the Monarch. Not much progress in the treatment of zinc ores was made during the year.

Coal and Iron

The gross production of coal in 1912 was 3,066,000 tons, of which about 395,000 tons were used in making coke; the quantity marketed as coal being about 2,650,000 tons. The quantity of coke made was 264,000 tons.

No progress was made toward the establishment of works for smelting any of the large deposits of iron ore known to exist in the province.

⁂

San Toy Mining Co.

The report of the San Toy Mining Co. for the year ended Dec. 31, 1912, shows that at this Mexican property the ore mined was 7851 tons, and 7324 tons was sold. Silver produced was 485,712 oz., or 66.3 oz. per ton. Lead produced was 260,989 lb., or 1.8% of the ore.

The average net value of silver was 60.07c. per oz., and average net value of lead 2.84c. per lb. Throughout the year, with the exception of the early part of January, during which a miners' strike was in progress, mining operations were continued without interruption; but for months at a time it was impossible to ship ore on account of the suspension of railroad traffic between Chihuahua and Torreon.

As in former years almost the entire production came from the horizontal orebody above the first level of La Central shaft, the only exception being a small amount that was taken from the pipe encountered by the main crosscut driven on the first level from La Central shaft to the western boundary and referred to in the last annual report. This pipe is still being followed, but no enlargement has as yet been encountered. The main orebody was followed during the year 329 ft. west, and 197 ft. north, and during that progress showed the customary variations in quantity and values. At the date of the report the face of the stope was larger than usual, containing ore somewhat above the average in value.

General unsettled political conditions, which have prevailed in Mexico, and which still prevail, have made operations difficult and results disappointing. Direct losses have been small, but the indirect adverse effects have been many. The gross income was $301,517.62 and expenditures $195,060.09, leaving net earnings of $106,457.53 for the year.

⁂

The Value of the Quebec Mineral Production for 1912, according to preliminary figures of the Mines Branch, was $11,017,046, as compared with $8,679,786 in 1911. Asbestos heads the list with a production of 111,175 tons. The output of copper and sulphur ore was 62,107 tons, an increase of 23,553 tons over the previous year. A marked increase in the production of structural material was shown.

DETAILS OF PRACTICAL MINING

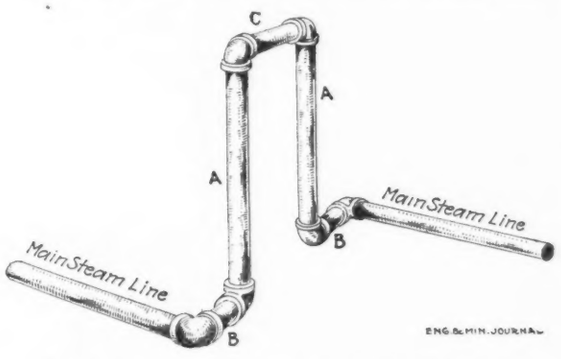
Cheap Expansion Joint

By Fred D. Smith*

In the Journal of Apr. 13, 1912, there is described a method of hanging air pipes so that the expansion due to the increase in temperature is taken up by the side swing of the pipes in supporting turns placed at intervals. This device would hardly suffice for steam lines, since the expansion is so much greater that the joints and elbows would be severely strained and undoubtedly broken.

Some time ago I had occasion to install a 3-in. steam line 800 ft. long, for a temporary supply of steam from a distant boiler to the hoisting works at the Snow Creek mine, and at the suggestion of Albert Geiser, of the Bonanza mine, I dispensed with the usual expensive expansion joints, and used what we chose to call a "shears," made of the same size pipe as the main line, and so called because as the line expands, the mains slide past each other and the upright portion of the "shears," or nipples *A*, become crossed, thus appearing as shears.

The accompanying drawing shows the arrangement of



Cheap Expansion Joint for Steam Lines

the device, which requires five nipples and six ells. The nipples *B* and *C* may be of any length, however short, while the nipples *A* should be of a length proportionate to the length of the steam line. In this 800-ft. pipe line the nipples *A* were made about 30 in. long. No strain or tension can come on the ells since the nipples can all turn in the elbows. It is suggested that the pipes at these joints should be put together with graphite rather than with white lead, thus insuring easy movements of the nipples in the elbows. Since there are no less than six threads on which these turns can be accomplished, there is little or no danger of a sufficient turn in any one elbow to open the joint and cause leakage.

As but one of these arrangements was used in the 800-ft. line, the movement in the shears amounted to about 3 ft. While I have never made use of this device in a steam line in a shaft, yet I think it could be available by setting one about every 100 ft., and thus requiring probably only about a 12-in. length in the nipple *A*.

*General manager, Snow Creek mine, Greenhorn, Ore.

Handling Material in Lake Superior Rock Houses

The rock houses of the Lake Superior copper country are usually built into the headframe so as to form an integral part of it. A small bin is provided for the skip discharge, rectangular in the older ones and circular in the newer. Provision is thus made for keeping the skips running in case a mass of copper gets stuck in the crusher, or in case the crusher has to be stopped for a while on account of some other difficulty. At the mines north of Calumet, where the dips are flat, the skips dump over a grizzly, either directly to the crushers or to a feeding apron, as at the Calumet & Hecla.

The small bin provided for the poor rock in the Copper Range houses, is served by a special skip-dump, while at the other mines the skip is made to dump into the poor-rock bin by throwing an apron in or out. A wearing surface of poor rock is provided for the dumped material so as to eliminate the cost of maintaining plates on the dumping plat. The bin floors are also protected in a similar way by dumping in poor rock, to fill the bottom of the ore bin, this material being allowed to assume a slope on which the ore will run.

The ore coming from the mine contains large boulders, many of them just small enough to enter the crusher mouth. The crusher is usually a 24x36-in. Blake type of Farrell make, crushing to about 4-in. size. The heavy crushers, which generally weigh around 40 tons, are carried about 45 ft. above the ground in the rock houses. Generally a grizzly is provided to screen out the rock below that size, and to let only the oversize go to the crushers, but that is not done at the Copper Range shafts, since experiments there have shown that a more evenly crushed product is obtained when the fines are fed to the crusher along with the coarse, slabs being then unable to slip through the jaws unbroken. Theoretically, this entails a little more consumption of power, but the increase is not appreciable in practice, and the rather considerable cost of upkeep on the grizzly bars is eliminated.

The manner of feeding the crushers differs. At the Calumet & Hecla mines, the ore dumps on an immense apron. At the other mines, where a bin is used, two gates are provided, which form a "lock" where the ore can be stopped and masses of copper picked out before reaching the crusher and causing trouble. With the two gates it is impossible for the ore to run when a boulder gets caught in the first gate, as the second gate is placed close enough to back the ore up to its angle of repose. This auxiliary gate is always set at the end of a short inclined chute which leads to the jaws of the crusher. The main gate is of the counterweighted, slide type, lifted and closed by means of an air-jack. The auxiliary gate may be of various types. At the Quincy rock houses, it is merely an apron gate, pushed up from below by an air-jack. Incidentally two grizzlies are used at the Quincy, one to take out the fines and the other to take out bould-

ers too large for the crusher. This system was formerly used also by the Copper Range, but has been discontinued along with the fine grizzly. The auxiliary gate at the Copper Range houses is of the arc type and is carried on the frame of the crusher itself. It is counterweighted and operated by an air-jack suspended overhead.

Here also another air-jack, suspended from a trolley traveling on an overhead I-beam, is provided to lift out of the chutes, by hooking into a chain thrown around them, any boulders too large to go through the crusher. The boulders, after removal, are taken to a heavy drop hammer, placed alongside the end of the bin, and there broken up. This drop hammer is operated by a rope from the main shafting of the crusher house. At the Copper Range mines it is the only device used in cleaning the copper masses, as the upkeep on a steam hammer is too high to pay for its use. Many of the rock houses at other properties, however, are provided with a steam cleaning-hammer, in addition to the drop hammer, for pounding the masses of copper and cleaning them of adhering rock. The steam hammers clean more thoroughly than the simple drop hammer, and it is the amount of mass copper produced which determine whether or not it pays to use a steam hammer for the purpose.

The frames of all the newer rock houses are of steel, and are covered with corrugated iron. In most instances the runway of the skip is covered from the collar up to the sheaves. This is largely a matter of the dip and the runways are less commonly covered where the dip is flat. Recently there has been a tendency to leave the tracks open. There is, then, less trouble with fog during the winter at upcast-shaft rock houses. This fog in some instances becomes serious, and if the skipways are covered, a partition must be carried through the building to keep the fog from around the crushers.

⁂

Aluminum for Electric Shaft Cables

Aluminum would seem to offer many advantages for use in a shaft cable conducting electric power underground since weight is there a matter of considerable importance. According, however, to E. Kilburn Scott, in a paper read before the Association of Mining Electrical Engineers of England, Feb. 7, 1913, it has not yet been applied to this purpose in England. The fear has been expressed that, owing to its high capacity, the increased effect of resonance might cause piercing of the insulation, but nothing of this kind has occurred in surface aluminum cables. The metal is unaffected by bad water and by sulphur. The oxide which forms on its surface is an excellent insulator. For a given resistance and length, an aluminum conductor will weigh approximately one-half as much as a copper conductor.

The fear that aluminum is unsuitable for shaft cables on account of the possibility of undue stretching during erection, is not based on facts. Hard-drawn aluminum wire is better than either copper or steel for supporting its own weight, and when annealed it is only slightly below steel in this respect. Thus, the maximum lengths in feet which would be self-supporting are: Copper, hard-drawn, 15,500; annealed, 5950; aluminum, hard-drawn, 25,000; annealed, 13,600; steel, hard-drawn, 20,700; annealed, 14,750.

It is true that aluminum is a material difficult to join, but in a shaft cable this has to be done at only one or two points. Solders are available but not easy to use. Electric welding makes the best job, but cannot be conveniently applied, as the great heat is liable to injure the insulation. The best device is a mechanical joint, which gives sufficient pressure to break down the layer of nonconducting oxide on the surface of the aluminum.

⁂

Concrete Stringers for Incline Tracks

By Claude T. Rice

In the Michigan copper country the use of concrete stringers under the skip tracks for the amygdaloid mines is standard practice, unless the footwall gives trouble from swelling. These were first used by the Ahmeek, and the method of fastening the rails adopted from that mine by the Mohawk is shown in Fig. 1. The method

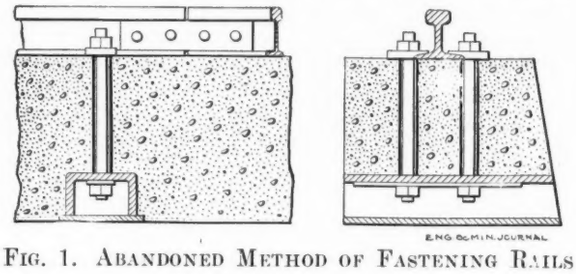


Fig. 1. Abandoned Method of Fastening Rails

has two disadvantages. In the first place a large amount of metal is used, since at 3-ft. intervals there is a channel through the stringer to give access to the track bolts, and these bolts themselves are carried in pipes and require bottom plates and beveled clips to grip the rails. A more serious difficulty is the fact that when a skip jumps the track it is liable to cut the heads of the bolts, which cannot then be extracted and replaced except by cutting the bottom nut or the bottom of the bolt itself.

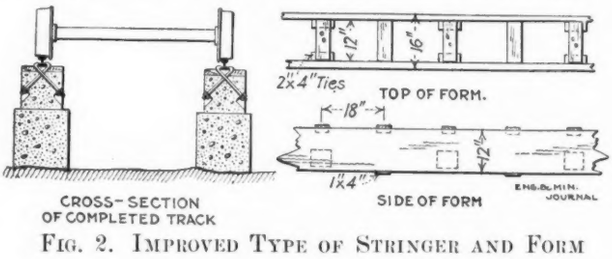


Fig. 2. Improved Type of Stringer and Form

To remedy these difficulties, the form of stringer shown in Fig. 2 was devised by W. F. Hartman, engineer for the Mohawk and Wolverine companies. Its advantages are manifest. The use of channels and clips is eliminated, the bolts are accessible and, in the most improved form, the use of pipes to carry the bolts is avoided by inserting ⅞-in. bolts in the forms, and withdrawing them when the concrete is partly set, leaving a suitable hole for inserting the ¾-in. bolts. The head of the bolt is also less exposed. The bolt holes are enough larger than the bolts so that an adjustment of ½ in. in the alignment of the track is possible.

The system also involves the used of 2x4-in. creosoted ties at 18-in. intervals to take the shock of the skip off the concrete, as described in the Journal, Apr. 12, 1913, by R. B. Wallace.

The arrangements of the forms for the 12x12-in. stringer is shown in Fig. 2, and the method of supporting

these and the forms for the foundations of the stringers, is shown in Fig. 3. The 2x4-in. ties bind the tops of the form sides during pouring and 1-in. pieces across the bottom perform a similar function there. The recesses for the bolts are formed by small blocks of wood nailed to the sides at the proper intervals. The forms are supported on 2x4-in. pieces extending across the shaft. Vertical 2-in. planks, nailed to the form sides and extending to the shaft bottom, serve as forms for the concrete foundation. Before concreting, the shaft foot wall is carefully cleaned. The forms are set in place by timbermen and lined up by a surveyor for direction and dip.

The concrete is mixed on the level above and slid down in 18- to 24-in. troughs, to a shoveling platform at the point where used. The work is done in 100-ft. lifts. A crew of from six to eight men can pour 100 ft. of double track in 24 hr. As fast as the form is filled, the cover

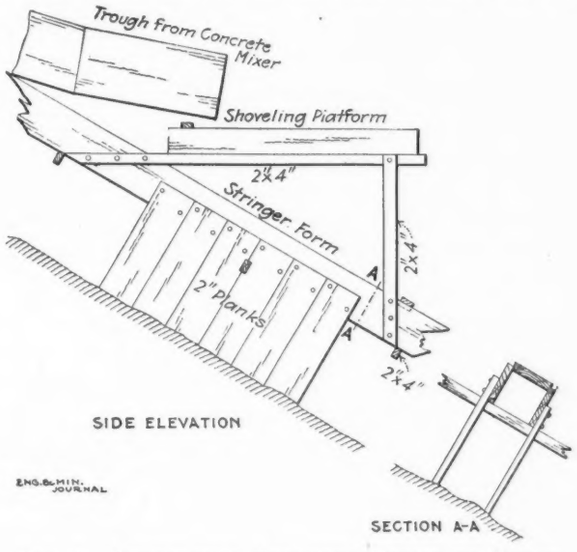


FIG. 3. SUPPORTING STRINGER FORMS IN SHAFT

is nailed on. The forms are left 36 hr. or longer. The concrete is mixed 1:2:5; poor rock from the mine is used, crushed in rolls to pass two inches and not screened or cleaned.

Raising at the Carter Mines

A four-compartment raise is being lifted at the property of the Carter Mining Co., at Ohio City, in Gunnison County, Colo., to reach the bottom of the old Volunteer shaft, which is full of water. The raise compartments are 3x4 ft. in the clear, the ladder and pipeway and the cageway being in the center, and the two rock chutes on the sides. The raise is to be 1089 ft. high, and Apr. 1, was more than 115 ft. up. A flat bulkhead of 12x12-in. red-spruce timbers is used over the ladderway and cageway.

No blasting set of timbers is used, but the wall plates are reinforced underneath before blasting, and it is found that this is much better than using a blasting set. The wall plates are shot on only once before the next 5-ft. set is put up. The rock chutes are lined with 3-in. green plank, and, as the raise is vertical, they stand and wear well.

The outside of the raise, all around, is lagged with heavy slabs, and where the ground is bad, two or three thicknesses are used. These slabs and the chute lining are hoisted in 5-ft. lengths for each set. It is found that much time is gained by keeping the timbering and the sheave wheel close to the back, and using short lining and lagging instead of long pieces. A station and grizzlies are put in every 200 ft. The ladders are zigzag with a landing every 15 ft.; 15-in. ventilating and 4-in. compressed-air pipes are used, and it is found that a telephone in the raise pays for itself about once every 10 days in saving time.

Drying Out Electrical Machinery

Electrical machinery underground is usually operated in a damp atmosphere and, in the case of pump motors and generators in hydro-electric plants, undergoes the risk of occasional submergence. The following advice on drying electrical machines, given by Francis H. Davies, in *Power*, Feb. 18, 1913, will be of interest.

It is apparent from the results obtained after the Seine floods in Paris and upon other occasions, that most of the methods generally employed for drying out electrical machinery, are good, provided they are thoroughly carried out. The process of drying should be commenced without delay, for if the machine is left exposed to the air, the insulation may be destroyed. Flood water contains mud, decayed matter, usually oil and possibly acid from accumulators; therefore, a thorough washing is essential. Benzoline or gasoline will be found effective against oil and a weak bath of potash against acid.

There are different methods of applying heat for drying, such as fires, open or closed, steam heat and a current through the windings. If the machinery is small, it may be taken apart and baked in the ordinary drying oven. This is the better course with field coils of all sizes and small armatures. It may be necessary to extend the baking over several days, and insulation tests should be made at intervals.

A machine too large to take to the ovens must be dried where it is. There are available, the coke fire (preferably inclosed), the steam radiator and the electric current. The machine should be dismantled to some extent to allow the hot air to penetrate and the armature rotated at about its normal speed to throw out water by centrifugal action, but it is important that no potential be set up, or the insulation may be broken down. A closed stove is preferable to the direct action of an open fire, as the acid fumes of the latter are deleterious. A machine should be entirely inclosed by a wooden structure, the joints covered with stout paper to prevent leakage, or by a tarpaulin. One or more small fans, properly placed, insure a circulation which assists drying. A temperature of about 180° F. should be aimed at, and it may be necessary to maintain this for several days.

Electrical drying by a current generated in or passed through the windings is usually longer, but may be the only method available. At the start, it may cause damage by electrolysis or by actual breaking down of the insulation. Until the latter begins to test out at a fairly high value, currents at low voltage must be used. Armatures may be dried by being short-circuited at the brushes and run slowly with a weak field. As the insulation improves, both the field and the speed may be increased until the highest safe temperature is attained. The danger point is about 300° F., at which heat cotton commences to dis-

color. The commutator may have to be dried in an oven. If the insulation remains low obstinately, this is generally the place to look for the trouble. With a current from an external source the armature should be kept rotating slowly, tending to more uniform drying, particularly of the commutator.

Transformers are difficult to dry out when thoroughly wetted, owing to the depth of their windings, and it assists matters to remove external insulating wrappings. A low-voltage current should then be passed through the high-potential coils, the low-potential side being short-circuited.

Storage batteries were quite uninjured by several hours' immersion in the Seine floods, the higher specific gravity of the acid causing it to remain in the cells with little dilution. Nor does there appear to have been damage done by discharging through the water.

Modern underground cables properly installed are fairly safe against water damage. A lead-covered, impregnated, paper-insulated cable, well jointed with watertight boxes, will suffer no harm, and should the water find its way in, it is usually only necessary to cut off a few yards at the end where the water will be found to have penetrated in between the core and its immediate insulation. Rubber cables unprovided with a lead sheath will not stand so well unless thoroughly waterproofed and new, the insulation of old rubber cable being quickly destroyed by water and impossible to repair. Telephone underground cables of the dry-core or air-space, paper-insulated type are susceptible to water, and the slightest damp will injure them. It may be necessary then to take off the lead sheath, dry the cores in an oven and then resheath the cable, but usually a desiccating machine will prove effective. This consists of a small air compressor, receiver and four cast-iron cylinders containing bags of calcium chloride, all mounted on a truck. A special connection is made to the cable, and air is pumped in at 30 lb. per sq.in. It flows through the calcium-chloride cylinders and emerges perfectly dry, and then flows along the cable through the air spaces between the wires, and carries out the entrained moisture.

An Explosive of Increased Power

Increasing the power of an explosive by the addition of such metals as aluminum or silicon, whose oxidation during the explosion gives rise to an enormous amount of heat, is the method patented by Roberto Imperiali, of Brescia, Italy, under U. S. pat. No. 1,054,777. When tungsten is alloyed with aluminum, the thermal energy of oxidation is increased and the aluminum is rendered more resistant to the action of oxidizing salts. Tungsten may be alloyed with both aluminum and silicon and a still more advantageous result obtained, or the tungsten silicide can be used.

These mixtures or alloys reduced to powder before mixing increase the power of any explosive to which they are added, due to their great heat of oxidation. They can be added to explosive mixtures or to nitrated explosives, or can be used alone with a suitable oxidizing agent, such as ammonium nitrate.

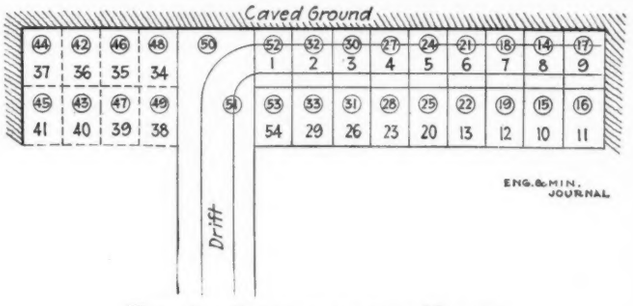
Such an explosive mixture can be made by drying and grinding the nitrate of ammonia and mixing in the alloy of aluminum, silicon and tungsten until the powder is substantially homogeneous. It is then dried and packed in cartridges. Combinations containing 65 to 85 parts, by weight, of ammonium nitrate and 35 to 15 parts of the metal mixture, may be used.

Top-Set Slicing, Mesabi Range

By Pomeroy C. Merrill*

A method of top-set slicing which has been used successfully for some years in one of the larger underground mines of the Mesabi range is illustrated in the accompanying diagram. It is similar to one suggested by L. D. Davenport in the Journal of Feb. 1, 1913. It has been used in hard ore, in clayey, wet, crushing ore and in soft hematite, under caved ground and under sand.

The numbers in circles in the figure refer to the top sets when the two-set method is used. In such case, the order represented by the figures in the drawing is followed; the cut is taken in for 35 ft. on the far side of the room next to the cave, removing lower sets only, and then four lower sets returning on the near side are removed



Top-Set Slicing on the Mesabi

and top sets are mined in the order shown. The room is then carried back toward the open sets under 50 and 51, the miners keeping the bottom set of the returning side ahead of the top sets on both sides, but sets 52, 53 and 54 are left standing, and the room is squared up, boarded and the timber blasted out. The smaller room on the other side of the drift is then mined similarly, in the order shown, and the timber there also blasted out.

In blasting down the mined-out rooms, it is seldom necessary to blast more than the center posts of the top set. In this way the room fills before the boards on the sides have had a chance to move. It is no rare sight to see every cap in the bottom sets of the far slice next to the caved ground resting on a post originally placed in the near slice. Blasting is by battery, and, together with the boarding up, is conducted by two blasters who go from room to room as required.

The advantages of this method are that it saves timber, since only one post is used in the center and frequently old posts are used on the far side; it saves shoveling, the top-set ore being run into cars through board chutes which can be quickly placed in any set; and it is safe. I have never heard of a serious accident directly attributed to this method.

To Remove the Insulation from Copper Wire the poorest way is to use a jack knife, says H. K. Scholefeld, in the "American Machinist," Mar. 6, 1913. The quickest way is to lay the wire on a metal surface and hit it three or four light raps with a hammer, thus pounding the insulating material to rags, which can be torn off with the finger and thumb.

*Mining engineer, Longyear Mesabi Land & Iron Co., Aurora, Minn.

DETAILS OF METALLURGICAL PRACTICE

New Method of Zinc Precipitation

A new system of precipitating gold and silver from cyanide solutions is described by J. S. MacArthur in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa for January, 1913. It consists of cutting up sheet zinc in a machine described as a "bookbinder's guillotine," so as to form strips about 1½ in. long and ¼ in. wide, the special merit of the cutting machine being that it distorts the strip of zinc so that it does not lie flat. These zinc strips are put into the compartments of an ordinary zinc box, and the merit of the shape is that they lie close together and form a method of forcing contact of solution and zinc without altogether stopping the flow of solution, although it is noted that much greater grade must be given the box than when shavings are used.

This form of zinc is said to be more economical than shavings, as the latter have been strained beyond the breaking point during cutting and consequently collapse and become useless before the zinc is actually used up in a chemical sense. The small pieces of sheet zinc are said to retain their strength until it is entirely consumed. sumed.

The method was first used at the Caviera mine in Portugal in 1907, and the resulting bullion contained only about 3% of zinc and 12% of other foreign matter, largely impurities remaining from the dissolved zinc. The thickness of the bed of this form of zinc is about 3 in., much more retarding excessively the rate of solution flow. The method is said to be economical of zinc.

❋

Slippage in Reciprocating Pumps

Losses by slippage in reciprocating pumps, according to Mervin K. Baer, in *Power*, Apr. 8, 1913, is due to three causes: (1) Leakage past valves, both suction and discharge; (2) leakage past pistons or plungers; (3) entrained air and air pockets. The first is the most important and is due to the necessarily late seating of the valves, to the wearing of the valves and springs and to improper seating. The second is due to wear on piston or plungers and is usually greater with inside-packed plungers than with the outside-packed type. Entrained air is caused by low suction pressures; air pockets are due to faulty construction. Neither of these last two losses should be found in a well designed pump.

Slip reduces the amount of water pumped and increases the power for a given quantity of water. The statement that it is generally about 5% is misleading, as it varies greatly. Piston speed and discharge pressure enter prominently into the question. Minimum slip occurs at the normal rated speed of the pump. It increases rapidly with a decrease in speed and increases slowly with an increase in speed. It is apparent that it is better to run a pump at high speed rather than low, so far as slippage is concerned. The slip also increases greatly with the pressure.

Tests on pumps of the Chicago water-works system, under normal operating conditions, show a slip varying from 11.7 to 28.5%. A smaller, boiler-feed pump, running under normal conditions at about 75 lb. pressure, had a slip of 58%. Slip varies greatly with the condition of the pump. Thus on a 40,000,000-gal. pump a slip of 1.7% was recorded on a certain date, the pump being in excellent condition. About four months later, this had increased to 28.5%. The necessity of considering slippage in pump calculations is evident.

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The City Deep Battery Foundation

In the new City Deep mill on the Rand the stamps weigh 2000 lb. each. These heavy stamps are carried upon the foundations illustrated in the accompanying

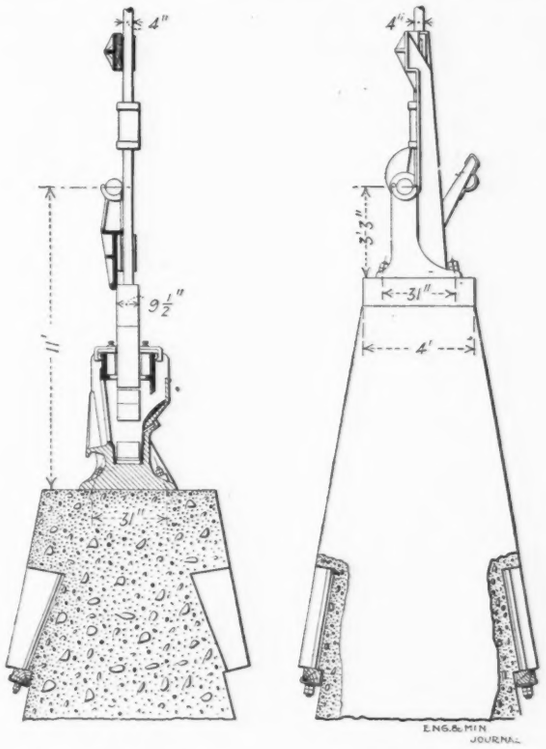

FIG. 1 FIG. 2

CROSS-SECTION OF BATTERY FOUNDATIONS

drawings. At first glance, the cross-section of this foundation recalls that used at the Goldfield Consolidated mill in Nevada, but this resemblance disappears upon closer inspection, for wood blocking is used below the overhanging parts of the concrete structure and the foundations are carried up as narrow pillars at each end and in the center of each 10-stamp block, which, with cast-steel mountings, constitute the king posts, which, in most stamp batteries, are made of wood.

These pillars are made of reinforced concrete. Upon them rests the enormous camshaft-bearing casting, and

the uprights which support the upper guides. Eight foundation bolts are used for each mortar casting, four in front and four in back. Besides these foundation bolts, the longer bolts that pass down through the reinforced concrete king post, which hold the camshaft bearings in place, are shown in the front elevation of the battery.

In the City Deep mill, the mortar boxes rest directly upon the top of the concrete foundation, apparently, from the illustrations, which are reproduced from "A Textbook of Rand Metallurgical Practice, Vol. 2," without the use of a rubber pad or other packing between the bottom of the mortar and the top of the foundation. This is quite at variance with what has come to be regarded in this country as typical South African practice, for we have been given to understand that in most of the mills on the Rand, heavy anvil blocks are to be found between the mortar and the foundation. In some cases, when such a cast-iron anvil block is used, it does not rest directly upon the top of the foundation, but upon a series of 14x14-in. pieces of Oregon pine laid close together and

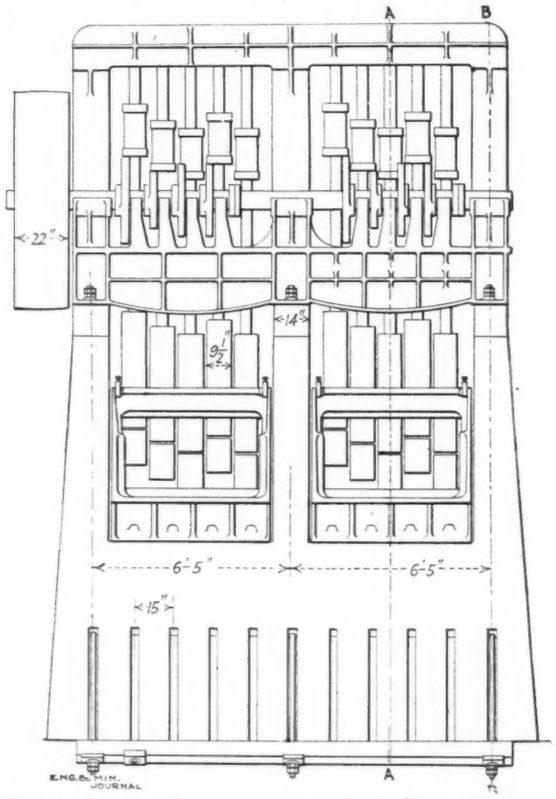

FIG. 3. FRONT ELEVATION OF CITY DEEP BATTERY

across the battery. However, in some mills, where no anvil block is used, it is customary to place a ⅜-in. rubber cushion between the bottom of the mortar and the top of the foundation. The experience of several stamp-mill designers in this country has shown that such packing is not at all necessary; to the contrary, they regard it as preferable to place the mortar directly upon the concrete. It is stated that in South Africa, the cost of the foundation when using anvil blocks is nearly double that when none is employed.

❖

Vitrified Clay Pipe Used for a Culvert should have the bottom of the ditch shaped to fit the pipe, including the bell, according to Bull. 45 of the U. S. Office of Public Roads, and if rock is present in the ditch bottom it should be excavated some six inches below the lower surface of the pipe and replaced with clay or sand.

Grinding-Pan Practice at Great Fingall

From investigations of the grinding-pan practice at the Great Fingall mine, Western Australia, E. Jensen (*Monthly Journal*, Chamber of Mines of Western Australia, January, 1913), states that better results were noted when corrugated shoes and dies were used because of the greater grinding surface obtained thereby. Another important factor was the pan speed. At the Great Fingall, better grinding results, with a lower consumption of power per pan, were obtained with a speed of 54 r.p.m. than when the pans were running at 58 to 60 r.p.m. Further, with extremely hard shoes and dies, the grinding results were not at their best. A general tapering of the grinding efficiency was noted as the shoes and dies wore. This was not the case with shoes and dies of ordinary hardness, the grinding efficiencies with them being approximately even during their whole life. By increasing the thickness of shoes and dies from 3½ in. to 4½ in., the life was lengthened at a comparatively small increase in the cost of each set.

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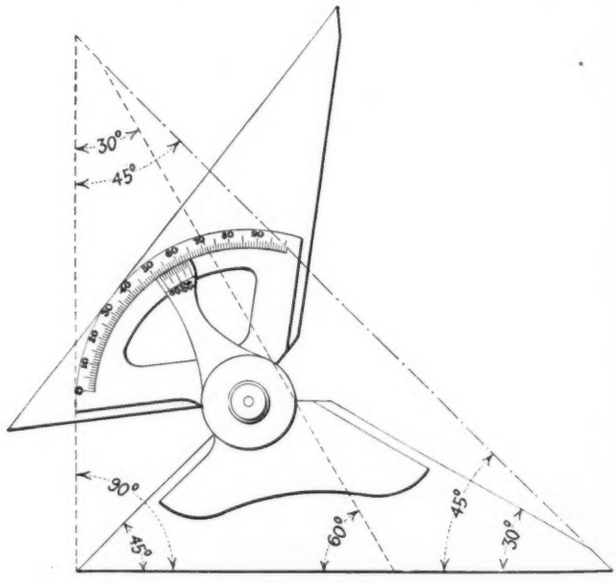
Combination Drafting Instrument

The accompanying illustration, from *Engineering News*, shows a combination protractor and triangles for the use of draftsmen. The protractor has an arc four



PROTRACTOR AND TRIANGLES COMBINED

inches in diameter, graduated to degrees and reading by a vernier to 5′, though it is probable that the setting of the instrument cannot be made with such minuteness. The clamping screw serves not only to hold the triangles in position but as a thumb-knob for handling the instrument. The instrument is claimed to be particularly convenient in setting off angles, dividing circles, drawing oblique parallel lines and perpendiculars to oblique parallel lines, transferring angles and for laying off angles on each side of a line without changing the setting. The protractor is steel and the triangles have transparent blades, the longest edge of which is 7 inches.

The instrument, which sells for $1.50, was invented by Edwin Z. Lesh, and is manufactured by the "3-in-1" Manufacturing Co., Hartford, Connecticut.

NOTES FROM CURRENT LITERATURE

Origin of the Cobalt Series

The Cobalt series of northern Ontario is the oldest formation resting on the basal complex. It is sedimentary in character, and different hypotheses have been advanced to account for its origin. Discussing these in the *Journal of Geology,* Vol. XXI, No. 2, Morley E. Wilson draws the following conclusions:

(1) The series is of terrestial origin; that is, it was not laid down in a large ocean. (2) The basal portion of the series is in place an ancient regolith. (3) The stratified graywacke, argillite, quartzite and arkose are lacustrine deposits. (4) Aeolian deposits are not represented in the series. (5) The climate of the period during which the series was laid down, was not arid or semi-arid, but was probably cold and humid. (6) The mode of deposition of the greater part of the conglomerate, both the basal and the top members, is most easily explained as the result of glacial action.

As evidence of the last statement, there is the fact that the boulders of the conglomerates have a characteristically "soled" appearance and striated pebbles and boulders have been found. The objection that striated surfaces have not been seen beneath the basal conglomerate, loses its point, in view of the fact that the contact has been observed only in a few cases. The Pleistocene formations now present in the district resemble closely the Cobalt series in their general characteristics and succession and represent glacial, interglacial and postglacial deposits. The matrices of the conglomerates resemble boulder clay and the occurrence in them of large rocks at a distance of several miles from the source of supply is most easily explained on the glacial hypothesis. The best alternative explanation, fluviatile deposition, does not meet the conditions of topography and climate which a study of the beds lying between the two conglomerates shows to have existed at that time.

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The Electro-Metallurgical Industry in France

A note of the progress of the electro-metallurgical industry in France appears in the *Mining Journal* for Mar. 1, 1913, abstracted from the *Journal du Four Electrique.*

In 1912 France exported 143,843 tons of bauxite for the manufacture of aluminum, and in 1911, 154,218 tons and 114,314 tons in 1910. Production in the Province of Var is increasing, the sales in 1912 being 210,000 tons. A factory for making emery by calcining rich bauxite has been built at Cannet-du-Lac. The Bouches-du-Rhone deposits are large, but rarely contain over 54% aluminum and the production has been only about 7000 tons.

In 1911 Russia exported 26,200 tons of bauxite; England, 40,620 tons; Germany, 25,611 tons; Netherlands, 30,887 tons; Belgium, 6932 tons; Austria-Hungary, 6675 tons; United States, 33,189 tons; Canada, 6000 tons, and other countries, 1682 tons.

In 1911, there were exported 8802 tons of red bauxite, used for making anhydrous alumina. Aluminum importation was insignificant, but exports were 6604 tons in 1912, 4054 tons in 1911 and 4147 tons in 1910. Of this, 846 tons were made into wire, sheets, powder, etc., though only 152 and 121 tons were thus used in previous years. Germany and Switzerland are the important producers of aluminum, which is principally in ingot form.

Exportation of calcium carbide constantly increases because of the growing use of acetylene gas in the French colonies. Importations in 1912 were 3302 tons and exportations 6225 tons.

The imports of calcium nitrate and cyanamide during 1912, together were 3160 tons. The nitrate imported came from Norway and the cyanamide from Switzerland.

Ferrosilicon imported in 1911 was 1677 tons and in 1912, 753 tons. Exports were 3598 tons and 3766 tons respectively. Of unclassified ferroalloys, 206 tons were imported in 1911 and 157 tons in 1912. The exports were 6749 and 6531 tons respectively. Ferrosilicon is exported to Germany and Belgium and the various ferroalloys to Great Britain and Switzerland. The exportation of potassium chlorate increased from 425 tons in 1911 to 1746 tons in 1912, while chloride of lime remains at about 13,000 tons.

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Determination of Sulphur Trioxide in Flue Gases

The determination of sulphur dioxide and trioxide in furnace gases by Lunge and Reich's method does not give satisfactory results, according to E. Richter, *Zeit. angew. Chem.,* p. 132, 1913; abstr. *Journ.* Soc. Chem. Ind., Mar. 31, 1913. Either the reactions with iodine and potassium hydroxide do not take place in the theoretical proportions or else substances are present which combine with a higher proportion of iodine than sulphur dioxide; at any rate the results for trioxide often work out as a minus quantity. The author describes a method for the determination of the trioxide by condensation. The apparatus consists of a tube of refractory glass surrounded by an iron jacket; this is connected with a vertical absorption tube, 30 to 40 cm. long, the inlet tube extending nearly to the bottom.

The absorption tube is charged with pieces of broken porcelain surmounted by a layer of garnets, plugs of glass-wool being packed above and below the charge. The tube is surrounded by a freezing mixture and the iron-jacketed tube being inserted in the flue of the furnace, a very slow current of the gases is drawn through the apparatus, and its quantity measured by means of an aspirator. The gas should be passed at the rate of about 1 liter in 25 min., and when a sufficient quantity has been treated, a current of pure dried air is drawn through to remove all traces of sulphur dioxide. The contents of the condensation tube are then washed out with water and the sulphuric acid is precipitated as barium sulphate.

Tests made to control the method showed that sulphur dioxide has no influence on the results, but that the tubes used to condense the trioxide yielded, when new, a small quantity of substances precipitated by barium chloride, which increased the result. This error of the apparatus was fairly constant and equivalent to 0.0005 gram of sulphur trioxide. Further, when a current of air is passed for 20 min. through concentrated sulphuric acid for the purpose of drying it, small quantities of sulphur trioxide are drawn over; it is advisable therefore to employ phosphorus pentoxide to dry the air. Lastly it was shown that the condensation of the sulphur trioxide in a sufficiently long absorption tube was practically quantitative and there is no necessity to use a second tube.

Causes and Prevention of Air Blasts

Replying to discussions of his paper on the subject of "Air Blasts and Roof Pressure" (*Journ.*, Chem., Met. and Min. Soc. of South Africa, January, 1913), Tom Johnson reiterates his belief that air blasts are the results of outbursts of rock in places where resistance to pressure is decreased. He offers as means of prevention a rapid working of faces, leaving no pillars, but cutting up the floor and making packs. With the cuts and packs kept close to the face, the cut will give relief to the floor and allow it to flow and thus ease the pressure on the face. The fast and regular working will keep the pressure from concentrating on the face line and the absence of pillars will give the roof opportunity to stretch and thus relieve the pressure. Where the pillars are giving trouble from bursting, packs can be put in and the pillars taken out, or the pillars can be bound with two or three turns of hoisting rope, clamped and wedged tight with lagging and slabs of wood. Rock outbursts should be defined as an explosion of rock from the solid face, but the crushing of pillars is the result of ordinary weighting. Many so called outbursts are merely caving. Outbursts seem to occur most frequently where thrusts have taken place; so tension cannot be the cause. They are not caused by heating and cooling. In clear, strong ground, it does not follow that outbursts will increase as depth is attained. Acknowledging the fact that rock can be made to flow, rock outbursts can be accounted for on the pressure theory, whether in stopes or in drifts.

World's Petroleum Production

The German Petroleum Joint Stock Co., of Berlin, publishes tables showing the world's petroleum production in 1912 (*Min. Journ.*, Apr. 19, 1913). According to these statistics, the total production amounted to 47,100,000 tons, against 46,100,000 tons in 1911. For 800,000 tons of this increase the United States is responsible, its output having aggregated 29,663,927 tons, against 28,878,870 in 1911. Russia's aggregate output advanced by 110,000 tons (9,263,566 tons, against 9,157,820 tons), the surplus of about 200,000 tons produced by the Baku fields having been more than sufficient to cover the deficit in the output of the Grosny wells. Roumania shows an increase of about 260,000 tons (total, 1,806,942 tons, against 1,544,847 tons in 1911). Galicia's output, on the other hand, has receded from 1,180,568 tons in 1911 to 1,455,660 tons. Among the other producing countries special mention is due to Mexico, which, with an output of 2,100,000 tons, shows an increase of more than 10% on the preceding year. The Dutch Indies, however, whose production is of special importance for Western Europe, on account of the high benzine contents of the oil, has supplied about 10% less than in 1911, the exact figures for the two years being 1,670,668 tons and 1,520,000 tons.

Clay Purification by Electrosmosis

A new method of clay purification is noted in the *Australian Mining Standard*, Mar. 13, 1913. If colloidal solutions or liquids in which extremely fine particles are suspended are subjected to an electric current, these finely distributed particles begin to move about. This is not to be confounded with electrolysis, since no decomposition takes place, and is called electrosmosis. The new method is based upon this process and is patented in Germany and abroad. A direct current is passed through a deposit of clay, the clay separating on the anode. The importance of the process consists in the clay being not only purified, but also refined. Even with clay containing considerable portions of sand and pyrites, the result is a product of great binding power and plasticity. It does not burn, neither does it show any spots. Osmosed clay is much in demand by makers of paper, colors, pencils and crayons. In ceramic factories it is employed for improving the plasticity of clay for crockery, etc. There is another feature inherent to the process of osmosis, this being the property, under proper conditions and when a direct current is used, to remove water from clay, which must be regarded as a colloidal substance, far more effectively than may be done mechanically under heavy pressure.

Cement-Making Material

A barrel of portland cement will consume about 450 lb. of limestone and 150 lb. of clay or shale. A plant making 1000 bbl. a day will, therefore, use, in the course of an ordinary year, about 66,000 tons of limestone and 22,000 tons of clay or shale. (*Bull.* 522, U. S. Geological Survey). Assuming average density for these materials, a 1000-bbl. plant will use up almost 1,000,000 cu.ft. of limestone a year, together with 250,000 cu.ft. of shale.

As the investment is heavy, it would be foily to locate a cement plant, under ordinary circumstances, at a point where less than 20 years' supply of raw material is in sight. A 1000-bbl. plant, therefore, should have 20,000,000 cu.ft. of limestone and 5,000,000 cu.ft. of clay or shale on its properties.

Magadi Soda Lake

A *Central News* correspondent states that Signor Cavicchioni has just forwarded his official report upon his visit to Lake Magadi, in East Africa. The report states that the lake in question is a lake of pure soda, and, although at a distance it appears to be of water, its surface is solid and dazzingly white. The lake comprises 30 sq.mi., and at present a considerable quantity of soda is daily taken from it, while a railway is under construction from the lake to the Uganda Railway. When the railway is completed it is expected that Lake Magadi will supply soda to the world.

Montreal Iron Mine, Gogebic Range

SYNOPSIS—A description of the surface equipment and the hoist safety devices, underground pump stations and mining methods of the Montreal mine.

The Montreal mine is situated near the western end of the developed portion of the Gogebic iron range, about five miles west of Hurley, Iron County, Wis., on a spur of the Minneapolis, St. Paul & Sault Ste. Marie Ry., over which road its ore is shipped to Ashland, Wis. During the navigation season the ore is shipped direct from the shaft-house pockets to the Ashland docks. When navigation closes the ore is graded and stocked at the mine.

In 1885 ore was mined from what is known as the "north deposits." These deposits, which were reached by means of vertical shafts through a comparatively short depth, are located about 500 ft. north of the line of the foot-wall. In 1886 the first shipment, amounting to 23,013 tons, was made. The mine has shipped ore continuously since that time. During 1912 its production amounted to 194,736 tons. Since ore was first discovered near its western boundary, operations have continued to the east and south, until at present the principal workings are to be found just overlying the quartzite foot-wall.

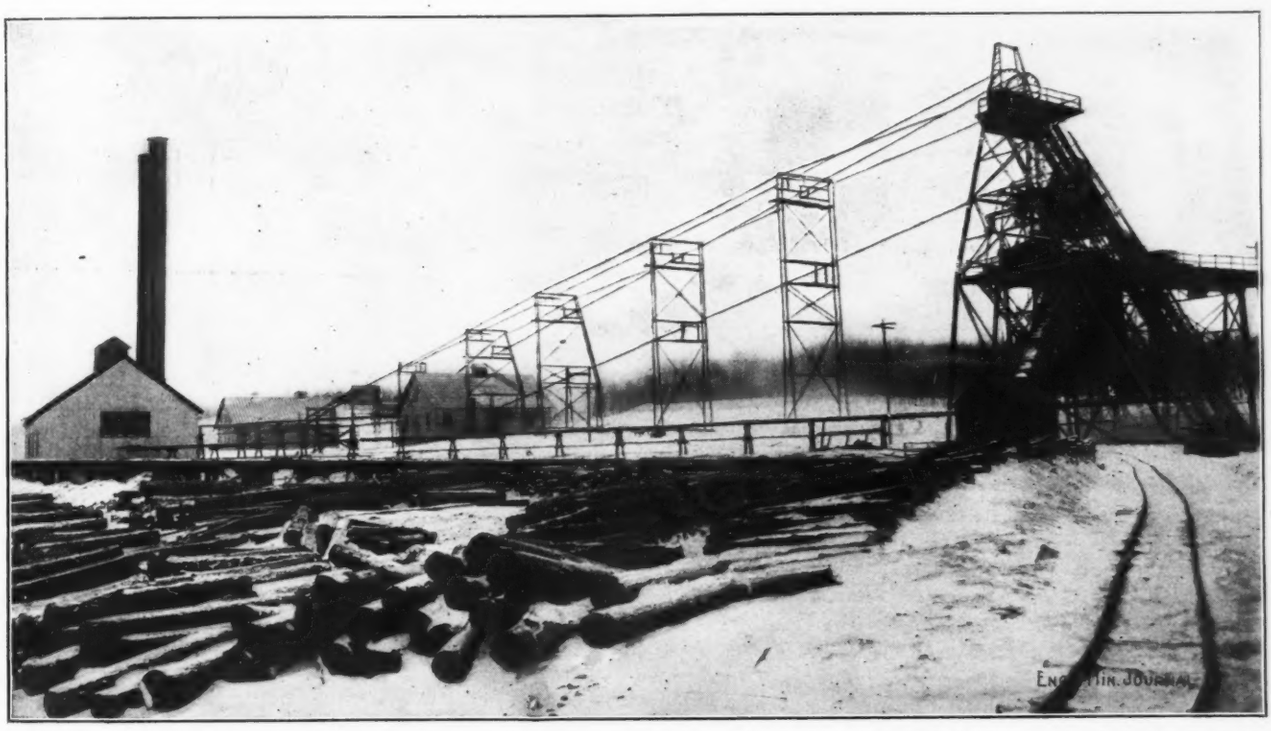


FIG. 1. SURFACE PLANT, NO. 4 SHAFT, MONTREAL MINE

POWER AND MACHINE EQUIPMENT

Two shafts are used for the regular mining operations, while a vertical cage-shaft is kept in repair as a means of safety to the underground employees. The No. 3 shaft, the older of the two, with two skip-compartments and one ladder- and pipe-way, has reached a depth of 1915 ft. The mechanical equipment of the No. 3 shaft consists of a boiler plant, containing three 150-hp. Wickes water-tube boilers, two 150-hp. Babcock & Wilcox water-tube boilers and one 150-hp. Sterling water-tube boiler; a 20x42-in. Bullock corliss hoist, geared to two 6-ft. drums, operating the cage and used in sinking; and a 22x48-in. Bullock corliss hoist connected to two 7-ft. drums, which operate the skips. The 20x42-in. cage hoist is shown in Fig. 2. It consists of a single corliss reversing engine, geared to a steel drum 10 ft. in diameter and 13 ft. long. A flywheel brake is provided to give adequate control. The reverse and brakes are steam actuated and an automatic throttle-closing device and automatic brakes are also provided on this plant, which is used principally for hoisting men and material. The speed is 600 to 800 ft. per minute.

Additional equipment includes an 18x42-in. Ingersoll-Sergeant duplex corliss air compressor and a 25-kw. Edison generator, used to supply power for the machine shop and in lighting the No. 3 plant. The machine shop, a building 32x60 ft., contains one 28-in. by 24-ft. Schumacher & Boye lathe, a 14-in. Sebastian lathe, a Dreses 60-in. Universal radial drill, a 24-in. Cincinnati shaper and a 30-in. Woodward-Powell planer, all of which are driven by separate, direct-connected motors. A National bolt-cutter and an Oster pipe-threader are driven from a small air engine which operates the line shafting. A Word Brothers drill-sharpening machine is used at this point.

The mechanical equipment of the No. 4 shaft plant consists of three 226-hp. Rust water-tube boilers, one 24x48-in. Sullivan geared corliss hoisting engine, con-

Note—An article by George E. DesRochers, Hurley, Wis., and the engineering department of the Sullivan Machinery Co., reprinted from "Mine & Quarry," April, 1913.

nected to one 10-ft. drum, used in operating a double-deck cage through a depth of 2150 ft., a 16 and 28x24 and 14½x24-in. Sullivan tandem compound corliss air compressor, and a 28x60-in. Sullivan duplex first motion corliss hoist connected to two 12x12-ft. drums, which operate the skips. This last hoist is connected to the drums through band friction clutches. The drums are grooved for 1¼-in. steel rope, and provide a capacity in depth of 3500 ft. With boiler pressure at 150 lb. this plant will hoist an unbalanced load of five long tons of ore in addition to the weight of the cable, when operating in balance, at an average speed of about 2500 ft. per minute.

Safety Devices for Hoist

The band friction clutches, band brakes and reverse are all steam operated. The hand-wheel on the engineer's platform enables the brakes to be set by hand in case of emergency. The reverse engine is a disk-shaped cylinder, with gears cut in its circumference, and is mounted on a horizontal shaft, just in front of and between the two drums, as shown in Fig. 3. A device is provided for automatically closing the main throttles at a predetermined point in the hoist, so that the cage or skip is hoisted the rest of the way by the stored energy of the moving parts. The engineer is not allowed to close the throttles nor open them again until the engines have been reversed for the down trip. Auxiliary or by-pass throttles are provided, to accomplish short movements. This provides not only safety but economy as well. Many hoisting engineers will not touch the throttles until late in the trip, at least part of the time. The hoist is then running at such speed that the brake has to be applied to arrest the momontum long before the landing is reached, whereas had the throttles been closed several revolutions earlier, just so much steam would have been saved instead of being wasted in the neutralization of its energy by the brakes.

The automatic brake is a second safety device used on the Montreal hoists. This automatic brake prevents an overwind, in case the engineer neglects to set his brakes at the proper time. A device is provided which admits steam to the brake engine early enough to stop the hoist before the cage or skip can pass the dump and cause damage. This mechanism interlocks with the throttle-closing device in such a way that the brakes cannot be released nor the main throttle be opened until the engineer leaves his platform and unlocks the mechanism by pulling out a stop block or pin. If the drums are clutch driven, the devices are arranged so that when one of the drums is thrown out the automatic throttle-closing mechanism and automatic brake, actuated with that drum, are disconnected and go out of use with the drum. Otherwise the unclutched drum would shut off the steam from the engine of the drum that is not unclutched.

These two devices render an overwind out of the question and permit high hoisting-speed to be employed with perfect safety. The screw shaft, traveler and levers constituting the mechanism just described are shown in Fig. 3 in front of the drum.

Hoist Used To Handle Rush of Water

It might be added here that with the aid of this hoist it was possible to prevent the drowning out of the pumps at the bottom of the shaft. A vug, carrying enormous quantities of water, was encountered on the 22d level. Water soon filled the bottom of the shaft, and had risen about two feet above the pump-house floor, when the skips were set to bailing. The shaft being in excellent condition, it was possible to hoist at high speed. Observations showed that a skip containing 84 cu.ft. of water was hoisted through 2150 ft. and dumped every two minutes. Without the aid of the bailing, the large pumps would probably have been drowned out.

A new 38x82-ft. frame dry-house to accommodate 332 men was recently completed. The lockers are di-

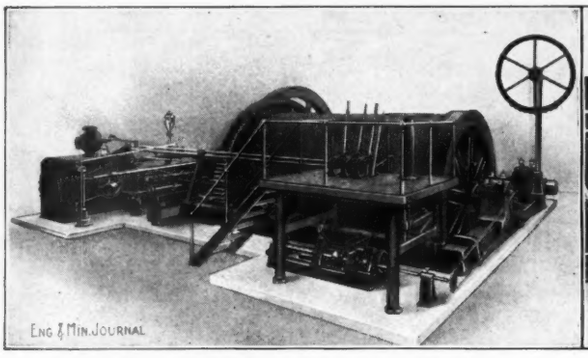


Fig. 2. Single-Cylinder Geared Hoist

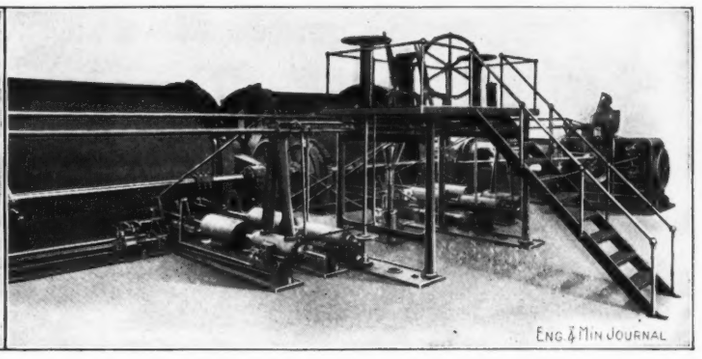


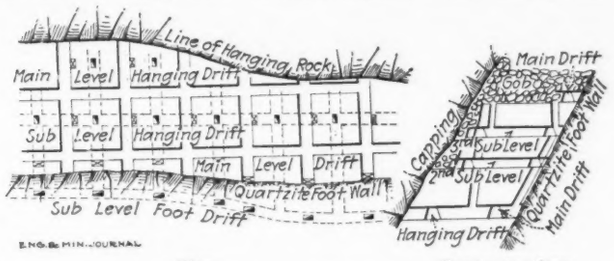
Fig. 3. Cage Hoist with Safety Devices
Montreal Mine, Gogebic Range

Fig. 4. Underground Pump Station

vided, each man using the lower half for his mine clothes and the upper half for his street clothes. Expanded metal bottoms and doors facilitate cleaning and permit a circulation of air throughout. These lockers were supplied by the Federal Steel Fixture Co., of Chicago. The No. 4 shaft has a steel head frame, as shown in Fig. 1, designed and erected by the Wisconsin Bridge & Iron Co.

Elaborate Pumping Station

In iron-ore mining, water is often a serious problem, and in order to meet this difficulty the Montreal Mining Co. has constructed remarkably fine underground pumping stations. The station on the twelfth level has a 20-ft. shaft pillar, while the station on the 25 level (the same in other details) has a 40-ft. shaft pillar. Both are in the foot-wall slates. The pump house proper, which is 35x65 ft., is made of stone walls, reinforced with 6-in. I-beams, which support 35-ft. 6-in. I-beams, used as caps. At right angles to these caps, 16-lb. rails are placed every two feet apart and run the entire length of the pump house to support ¼-in. by 5x5-ft. steel plates, which make an entire steel ceiling or back for the station. A general view is given in Fig. 4. Aside from a little cedar lagging used as blocking, on top of these plates, this station is absolutely fireproof. A sump 9x15x15 ft. deep with center partition occupies one corner of the station. Each pump house is equipped with a 16 and 25 and 42x9½x24-in. triple-expansion, pot form, condensing, mine pumping engine; a 20 and 37x9½x24-in. compound, condensing, semi-rotary valve mine pumping engine and two 10x18x18-in. independent air pumps and condensers, one at work with each pump. The pumps and condensers were made and installed by the Fred M. Prescott Steam Pump Company.



Plan Cross-section

Fig. 5. Method of Developing Stopes

The iron ore is found just overlying the quartzite foot-wall and usually in a trough, formed by dikes dipping toward the foot-wall and pitching to the eastward. The width of the orebodies, which are somewhat lenticular in shape, varies from eight and 10 ft. to about 150 ft., that is, from the quartzite to the hanging-wall, which is on the order of ferruginous chert. The ore found here is of the soft, red, granular, bessemer variety, three grades being mined. The guarantee of the grades for 1913 is as follows: Montreal grade, 62.2% of iron, 56.23% natural iron, 0.048% of phosphorous; Lawrence grade, 61.07% of iron, 54.64% of natural iron, 0.055% of phosphorous; Hamilton grade, 61.32% of iron, 55.03% of natural iron.

Subslicing Used for Most of the Ore

The ore is obtained in some parts of the mine, where it occurs in narrow deposits, by the simple back-stoping method, but most of it is mined by using a "subslicing" method, a term which I believe is colloquial in the Lake Superior mining region. A brief description of the subslicing method, is as follows: The main drift is driven near the foot-wall on the average strike of the formation in order to get as straight a drift for haulage as is possible. Crosscuts are then driven to the foot- and hanging-wall at right angles to the main drift at 50-ft. intervals, starting from the shaft crosscut and going east. Where the orebody is more than 50 ft. wide, a hanging drift is driven 50 ft. north of the main drift and parallel to it, as shown in Fig. 5. Raises are put up on the foot-wall to the next level above, midway between the crosscuts and also from the sides of the crosscuts, raising either to the east or west. The raises are cribbed with 6-in. round timber, the inside measuring four by eight feet, and are partitioned with cribbing so as to furnish a ladderway and an ore compartment. It is the practice to keep the cribbing close to the back of the raise. During the raising operation, sublevel openings for the third sublevel are always cut out and two regular sublevel drift sets put in, which are lagged over with poles. The raises are vertical from the third sublevel to the next main level, shown in Fig. 5, in order that they will come out on the hanging side of the main drift, rather than in the main drift proper. Trap doors cover the ladderways and pieces of old steel rails are set about 15 in. apart across the ore-compartment opening. In developing, the next step is to open up the third sublevel, which measures 61 ft. from the back of the main level up to the bottom of the sublevel. A drift is run along the foot-wall connecting the raises which have previously been put up, and crosscuts driven every 50 ft. at right angles to this drift, extended to the hanging-wall. These crosscuts are so started as to lie directly above the center of the pillar formed by the two crosscuts on the main level, and will connect with the raises from the main level crosscuts which go up to the east or the west.

Where the orebody is more than 50 ft. wide, a hanging drift is also driven, as on the main level. When this "sub" is developed and ready for stripping or slicing, the second "sub," which measures 36 ft. above the back of the main level, is started and developed in a similar manner. Timber and lagging are lowered from the upper level during the development stage of the sublevels. Assuming that the third sublevel is fully developed and that all ore has been mined out over the main level above, stripping is started by drifting east and west from the crosscuts just under the hanging rock or on the hanging side of the orebody, to the center of the pillar, and breaking down the ore overhead as the stripping operation is drawn back to the crosscut from which the miners started.

Small 1-ton tram cars are used on the sublevels to tram to the nearest raise, seldom over 50 ft. away, the ore which cannot be shoveled direct into the raises. The next slice is taken off in a similar manner, and thus the entire pillar or pillars are worked back to the foot-wall. The gob or cave material follows in behind. In the meantime slicing has been commenced on the next sublevel below but carried back just at the proper speed to keep the miners below under the cave of the miners on the third sublevel. This work is carried on down, the main levels being eventually stripped in a similar manner.

It is the practice here to keep all drifts and crosscuts

timbered and lagged right up to the breast. In the main drifts, 8-ft. posts and 10-ft. caps are used; in the crosscuts 8-ft. posts and 8-ft. caps and on the sublevels, 7-ft. posts and 7-ft. caps. A grade of 0.42% is maintained in all the main drifts.

In conclusion, I wish to express my appreciation of the kindness of George H. Abeel, general manager.

April Mining Dividends

April dividends of United States mining companies reached no less a figure than $9,856,355, paid by 43 companies. This includes another of the Kennecott million-dollar disbursements, but does not include the dissolution dividend of the Elm River company. Iron, industrial and holding companies affiliated with mining paid $4,514,502, while Canadian, Mexican and Central American companies paid $2,927,186. Of these no less than eight were in Mexico. As compared with April, 1912, the three classes show increases of $2,811,085, $858,144, and $1,411,975, respectively. The totals for the first four months of the year are: For United States mining companies making public reports, $29,690,169; iron, industrial and holding companies allied to mining, $32,793,408; and Canadian, Mexican and Central American companies, $9,494,122.

United States Mining Companies	Situation	Per Share	Total
Ahmeek, c	Mich.	$7.00	$350,000
Am. Zinc, Lead & Smelting, z.l	U. S.	0.50	88,100
Anaconda, c	Mich.	0.75	3,249,375
Arizona, pf. A.c	Ariz.		5,769
Bunker Hill Con., g	Calif.	0.02½	5,000
Bunker Hill & Sullivan, l.s	Ida.	0.20	65,400
Centennial-Eureka, l.s.g.e	Utah	1.50	150,000
Champion, c	Mich.	1.00	100,000
Center Creek, l.z	Mo.	0.00½	5,000
Copper Range Con., c	Mich.	0.75	295,084
Daly Judge, s.l	Utah	0.15	45,000
Eagle & Blue Bell, g.s.l	Utah	0.05	44,657
Elm River, c	Mich.	0.19*	19,000*
Ernestine	N.M.	0.05	15,000
Fremont, g	Calif.	0.02	4,000
Frontier, g	Wis.	2.00	2,500
Golden Cycle, g	Colo.	0.02	30,000
Goldfield Con., g	Nev.	0.30	1,067,744
Grand Central, g	Utah	0.05	25,000
Homestake, g	S. D.	0.65	163,254
Hecla, l.s	Ida.	0.02	20,000
Iron Blossom, s.l.g	Utah	0.10	100,000
Iron Silver, s.l.g	Colo.	0.10	50,000
Kennecott, c	Alas.		1,000,000
Moscow, g.s	Utah	0.01	8,176
Mary McKinney, g	Colo.	0.02	26,185
New Idrea, q	Calif.	0.10	10,000
North Butte, c	Mont.	0.50	205,000
Old Dominion, M. & S	Ariz.	1.25	202,500
Osceola, c	Mich.	3.00	288,450
Portland, g	Colo.	0.02	60,000
Silver King Coalition, s	Utah	0.15	187,500
Snow Storm, c.g	Ida.	0.01½	22,492
Tom Reed, g	Calif.	0.07	63,669
Tonopah-Belmont, g.s	Nev.	0.25	375,000
Tonopah, g.s	Nev.	0.40	400,000
United Copper, c	Wash.	0.01	10,000
United Globe, c	Ariz.	7.50	172,500
United Verde, c	Ariz.	0.75	225,000
Utah Con., c	Utah	0.50	150,000
Vindicator, g	Colo.	0.03	45,000
Wolverine, c	Mich.	5.00	500,000
Yellow Aster, g	Calif	0.05	5,000
Yellow Pine, l.z.s	Nev.	0.02	19,000

Iron, Industrial and Holding Companies	Situation	Per Share	Total
Am. Ag. Chem., com	U. S.	$1.00	$171,141
Am. Ag. Chem., pfd	U. S.	1.50	275,730
Am. Sm. Sec., A	U.S., Mex.	1.50	255,000
Am. Sm. Sec., B	U.S., Mex.	1.25	375,000
Bethlehem Steel, pfd	U. S.	1.25	186,350
Cambria Iron	Penn.	2.00	169,360
Guggenheim Exploration	U.S., Mex.	0.62½	519,832
Harbison Walker, pfd	U. S.	1.50	144,000
La Belle Iron, pfd	Ohio	0.50	49,477
National Carbon, com	U. S.	1.50	82,500
Old Dominion, c	Ariz.	1.25	366,691
Penn Salt	Penn.	3.00	150,000
Republic Iron & Steel, pfd	U. S.	1.75	357,296
Sloss Sheffield S. & I	U. S.	1.75	117,250
St. Mary's Min. Land, c	Mich.	1.00	160,000
U. S. Sm. Ref. & Min. com	U.S., Mex.	0.75	263,329
U. S. Sm. Ref. & Min., pfd	U.S., Mex.	0.87½	425,530
Virginia-Carolina Chem	U. S.	2.00	419,766
Vulcan Detinning	N.J., Ill.	1.75	26,250

Canadian, Mexican and Central American Companies	Situation	Per Share	Total
Alacran, g.s	Mex.	$2.00	$19,200
Augustias, Dolores y Anexas, g.s	Mex.	0.75	1,500
Buffalo, s	Ont.	0.20	200,000
Butters-Salvador, g	San Salvador	0.36	96,750
Cobalt Lake, s	Ont.	0.03	112,650
Crown Reserve, s	Ont.	0.05	88,441
Dominion Steel, com	Can.	1.00	345,896
El Favor, s	Mex.	0.01	35,000
Encino y Anexas, g.s	Mex.	1.00	3,000
Hollinger, g	Ont.	0.15	82,500
La Rose Con., s	Ont.	0.25	374,656
Lucky Tiger, g	Mex.	0.05	35,764
Mazapil, c	Mex.	10.00	273,777
McKinley-Darragh, s	Ont.	0.10	224,769
Mines Co. of America, g.s	Mex.	0.12½	112,500
Nipissing, s	Ont.	0.37½	450,000
Nova Scotia Steel & Coal, com	N. S.	1.50	90,000
Nova Scotia Steel & Coal, pfd	N. S.	2.00	20,600
Porvenir y Anexas, l.s	Mex.	45.00	112,500
Seneca-Superior, s	Ont.	0.10	47,683
Standard, s.l	B. C.	0.02½	50,000
Temiskaming, s	Ont.	0.06	150,000

*Liquidation dividend.

Chronology of Mining for April, 1913

Apr. 1—More than 50,000 coal miners in South Wales gave notice that they would strike, May 1, in protest against the employment of non-union workmen.

Apr. 2—The territorial senate of Alaska passed a miner's eight-hour labor bill—Cananea Consolidated Copper Co. plant closed down as a result of political disturbances.

Apr. 3—Miners in Rio Tinto mines, in Spain, went out on strike.—Governor Ammons, of Colorado, signed the eight-hour law for miners, which went into effect immediately.

Apr. 7—Cave in Miami mine, Arizona, killed two men and injured fifteen.

Apr. 8—About 600 miners on the Cuyuna range, Minnesota, went out on strike.—Rio Tinto strike settled.

Apr. 10—Employees at the American Smelting & Refining Co. smeltery, at El Paso, went out on strike.

Apr. 16—Chile Copper Co., incorporated in Delaware with authorized capital of $110,000,000, to work Chuquicamata copper mines in Chile.—Miners in the employ of the Amalgamated Asbestos Co., at Black Lake, Quebec, went on strike for increase in wages.—Strike at Rio Tinto renewed.

Apr. 17—Employees of Grasselli Chemical Co. smeltery, at Meadowbrook, W. Va., went out on strike.

Apr. 19—Coal miners in the Upper Silesian mines in Germany went out on strike.

Apr. 21—James S. Douglas was driven out of Cananea, by a mob of unemployed men.—Strike on the Cuyuna range, Minn., ended.

Apr. 23—An explosion of gas in the Cincinnati mine of the Monongahela River Consolidated Coal & Coke Co., near Courtney, Penn., killed 96 men.

Apr. 23—Hoisting accident at Leonard mine, at Butte, Mont., five men killed and nine injured.

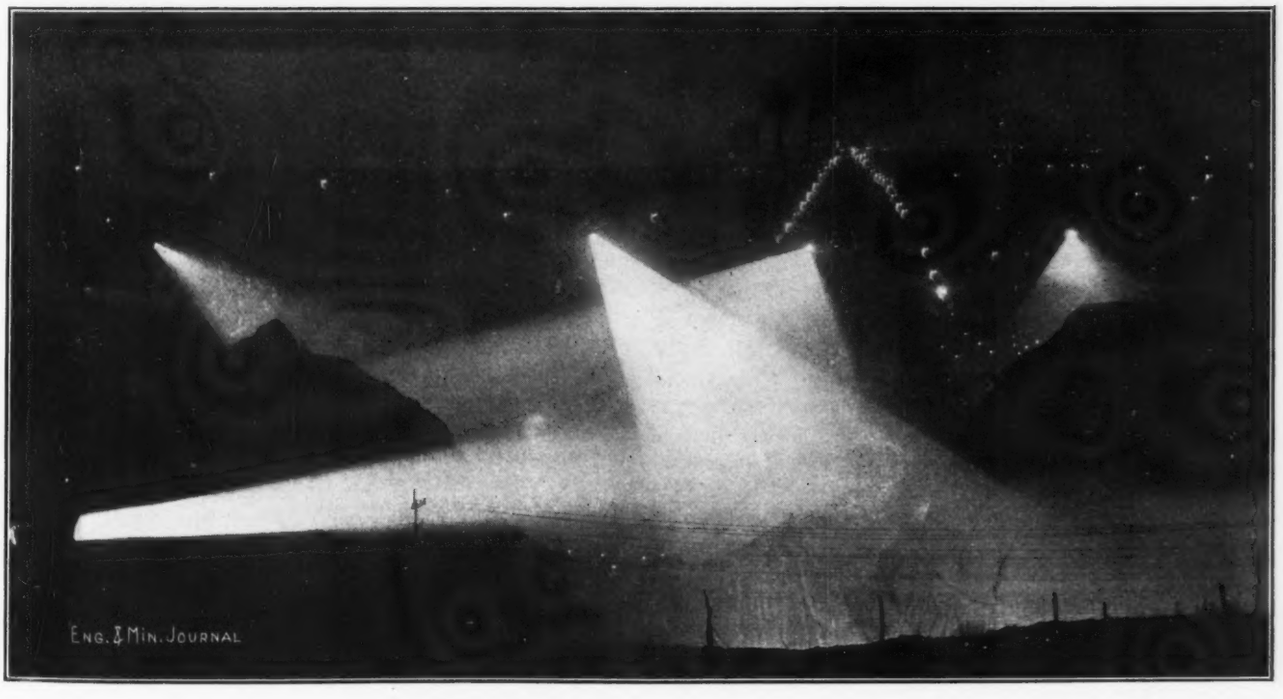
Apr. 25—Striking miners of the Kanawha coal field in West Virginia, voted to accept the proposals of Governor Hatfield for a settlement of the strike, which has been on for more than one year.

Apr. 26—Mass Consolidated mine, in the Lake Superior copper country, shut down on account of labor troubles.

Apr. 27—Blast-furnace forces at Perth Amboy, N. J., plant of the American Smelting & Refining Co., went out on strike.

Apr. 28—Grand Jury at Redding, Calif., brought in a report that the Mammoth smeltery, at Kennett, constituted a nuisance and that the fumes were injurious to agriculture.—About 40 miners in the mines of the Colorado Fuel & Iron Co., at Rouse, Colo., were caught in a cave-in.

PHOTOGRAPHS FROM THE FIELD



PREMIER DIAMOND MINE BY DAY AND BY NIGHT [Copyright by Danby]

(This mine is situated 12 miles east of Pretoria, Transvaal. The mine is worked to an average depth of 178 ft. About 10,000,000 tons were treated last year.)

Johannesburg Notes

By E. M. Weston

The Brakpan mines have been making large profits with their 160 heads of stamps and tubes, the ore being drawn from about 3500 to 4000 ft. in depth. They have over 2,000,000 tons of payable ore developed and are increasing the mill to 200 stamps. The adjoining Modderfontein Areas State mine is meeting with favorable results in development.

No tenders have been received for the new state mines area recently advertised on the dip of Brakpan and Modder areas as the percentage of profit demanded by the government is somewhat high for such a deep area of unproved ground. Undismayed by this, the government invites tenders for leasing 1180 claims on the dip of the Rand Collieries mines. Here, again, the government estimates of capital required would be largely exceeded, owing to the existence of hard diabase interbedded sheets which would render sinking expensive and slow. The Rand Collieries ground proved patchy and disappointing and work on this mine is almost stopped, though better results have lately been obtained. It might be possible to attack the new area from the existing shafts of that mine and thus develop it in combination with the present area.

In the annual report of the Chamber of Mines, some interesting figures were given as to the value of reefs disclosed in some of the deeper mines of the Rand. At the Geduld Proprietary, which lies east of the government mining areas, the reef was intersected in the third level at a depth of 1925 ft. vertical, assaying 12.1 dwt. over 48 inches.

The New Modderfontein circular shaft intersected the reef at a depth of 2158 ft., assaying 13.2 dwt. over 48.4 in. On the dip of this the Modder Deep levels at 3100 showed 10 dwt. over 46.8 in. over 420 ft. At the Cinderella Consolidated at a vertical depth of 4440, 1350 ft. driven and sampled showed 9.1 dwt. over 42 in. At the City Deep, at 3286, development on the main-reef leader gave a value of 14.7 dwt. over 28.9 in. In the Turf mines section of the Village Deep at the 19th level, about 4000 ft. vertical, the main-reef leader showed 10.4 dwt. over 36 in. At the Crown Mines at 2660 ft., the main reef and main-reef leader are wide and rich, the main-reef leader showing 11 dwt. over 132 in. The Consolidated Main Reef struck the reef in No. 3 vertical shaft at a depth of 2365 ft. assaying 17½ dwt. over 48 in. At Roodepoort, in the Princess Estate, at 2758 ft., 1690 ft. gave 9.31 dwt. over 26 inches.

These strikes do not settle the question as to whether the gold contents of the main-reef series decrease in depth. It is now generally recognized that the percentage of unpayable ore encountered in depth does increase. The most prosperous of the 3000- to 4000-ft. mines, the Brakpan mine, contains a large proportion of low-grade ore, and its presence is most noticeable in the East Rand Proprietary Mines and the Germiston mines, like the Simmer Deep. The grade at depth, however, is most encouraging, in view of the approaching exhaustion of several important outcrop producers. No. 4 shaft of the State mines and the shaft of the Springs mines, about four miles to the east, are expected to cut the reef at any time. Good assays reported from these shafts at a depth of 3500 ft. will stimulate the development of a large area of country at present lying dormant.

The Groenfontein tin mine has apparently exhausted its pipe deposit. The Zaaiplaats mine has encountered rich ore again. The Rooiberg mine is increasing its output and the neighboring Leeuwpoort mine has now in sight 100,000 tons of ore, containing 2.17% tin. It is developed to a depth of 452 ft. and is to start a plant in August to treat 4500 tons per month. Several other mines promise to become producers.

A rough estimate of the coal resources of the mines of South Africa is as follows: Transvaal, 500 sq.mi., 6-ft. seam, 36,000,000,000 tons; Natal, 1000 sq.mi., 7-ft. seam, 9,400,000,000 tons; Zululand, 1000 sq.mi.; 4,800,000,000 tons. The coal carries 6 to 30% of ash.

At the recent annual meeting of the Association of Mine Managers, the chairman stated: "During the year enormous progress has been made in allaying dust. With a continuation of the measures at present being adopted all along the reef, new cases of miners' phthisis should soon be of rare occurrence." As a correspondent in the local mining journal points out, much still remains to be done and there are still many unhealthy places. As a rule, the piping put in for water supply is far too small and when water is required it is often not available in the higher levels. On a government inspector's visit, it is an easy matter to send a man in advance to turn off the supply from the lower levels, so that water appears on all the upper ones.

It is expected that the joint recruiting agreement will save the mines at least £250,000 per year. Out of 2,500,000 tons per month stoped last year, it took 42,000 natives to break 800,000 tons, the rest being broken by rock drills.

⁂

Winona Copper Co.

The annual report to the stockholders of the Winona Copper Co., Michigan, for the year ended Dec. 31, 1912, shows total receipts amounting to $541,128 and total expenditures of $479,094, an excess of receipts over expenditures of $62,034. There are $5463 of unpaid assessments. One of the largest obstacles to successful operation of the mine during the year has been the shortage of trammers. This situation has been partly remedied but is said to be still unsatisfactory. The percentage of copper recovery in the mill has shown a small but steady improvement during the year. Part of this improvement has come from the installation of more regrinding apparatus. Three Hardinge mills have been installed and three more are ordered, which were expected to be installed in February, 1913.

The total expense for mining, hoisting, rock house, transportation, stamping, surface, office and incidentals amounted to $406,264. Development, mainly diamond drilling, amounted to $239. Construction, including electric light and telephone, mill machinery, mill repairs, and other similar items, amounted to $23,036, a total expense of $429,540. There were 181,148 tons of rock stamped producing 2,307,237 lb. of refined copper, which is equal to 12.73 lb. of copper per ton of rock stamped. The price received for copper was 16.306c. per pound.

⁂

One Cubic Yard of Sand Will Be Screened in 39.2 Min. from bank gravel by the average laborer, according to Taylor & Thompson's book of "Concrete Costs." This is equivalent to 13¾ cu.yd. in nine hours.

CORRESPONDENCE AND DISCUSSION

Pitot Tube in Gas Measurement

In the JOURNAL of Mar. 29, 1913, C. E. McQuigg contributes an article on the pitot tube for use in determining the rate of flow of gases in flues. It would add greatly to the value of this contribution if the writer would indicate in what way this apparatus is superior to Fletcher's anemometer, which has been in use for many years for the same purpose. At first sight, the pitot tube, as figured in the article referred to, appears to me to be objectionable, firstly on account of its having solder largely used in its construction, thus preventing its use in flues where the temperature is above, say 500° F., and, secondly, the form involves the cutting of an awkward-shaped hole in the wall of the flue to be tested. In the case of the Fletcher instrument the part inserted into the flue to be tested may be plain brass or iron tube of ⅜ in. internal diameter or less, generally ¼ in., and the form of the inserted ends is such that a round hole of ⅞ in. diameter is all that is required to be cut. In the case of a chimney with walls 2 or 3 ft. or more in thickness, a circular hole ⅞ in. diameter is easily bored with a drill, but in the pitot tube a slot about 5 in. long would have to be made—not an easy cut to make in a thick wall, working from one side only. There may, of course, be some points in which the new tube is superior to the instrument previously in use and, having had many years' experience with Fletcher's, I am naturally interested and trust your contributor will enlighten me, and others, on this matter. I need hardly, at the present moment, take up your space in describing the Fletcher instrument, as it is generally well known to those who have occasion to make tests of gas speed in flues. It is fully described in Lunge's "Sulphuric Acid," and full tables are there given for use with the instrument; these, I would add, save all the calculations and reference to curves which the Pitot tube seems to require.

T. C. CLOUD.

London, Apr. 21, 1913.

Shipment of Cyanide Precipitate

In the discussion regarding the shipment of cyanide precipitate, I would like to direct attention to one reason which may account, in some cases, for low results when shipping bars. This is the shipment of imperfectly refined bars, which yield such erratic assay results that the purchaser must necessarily put a low valuation on them for his own protection. In the annual report of the British Mint for 1896, Roberts-Austen describes a cyanide bar weighing 393 oz., which was paid for at £965. This bar was refined by itself and yielded gold worth £1028. The shipper of the bar lost £63 or over $300. After paying for the refining, such a loss might easily be fatal to shipment of bars as against precipitate in a comparison of costs.

In the JOURNAL for Apr. 13, 1912, I have given a table of erratic assays of cyanide bars from the Mercur mine. It would be a hazardous undertaking to determine from these assays just how much gold these bars contained. Some bullion deposited by the Mercur mine just before closing down was better refined and higher grade. Samples from three bars of these later shipments were assayed in duplicate in three laboratories with the following results:

	1st Bar Gold	2d Bar Gold	3d Bar Gold
1st laboratory	920.1 fine	916.3 fine	884.2 fine
	.2 fine	.7 fine	.5 fine
2d laboratory	920.8 fine	916.8 fine	884.5 fine
	.8 fine	.5 fine	885. fine
3d laboratory	920.1 fine	916.5 fine	884.0 fine
	.3 fine	.6 fine	.3 fine

These results show a vast improvement over the former assays of Mercur bars.

FREDERIC P. DEWEY,
Assayer Mint Bureau.

Washington, D. C., Apr. 28, 1913.

Preliminary Testing of Placer Ground

I read in the JOURNAL of Apr. 5, a most interesting article on preliminary testing of placer ground, by William F. Ward. In this article, he describes a combination of Empire and Keystone method, evolved by himself. I used the steam drill for many years, but recently have been using the Empire, and am now operating one at the Portis mine in North Carolina.

It would appear that Mr. Ward has missed some of the advantages that I find in the Empire method. Unfortunately, he gives no figures regarding his results, excepting the 21 ft. per working day that was averaged by him on the Nichi River, in Colombia. I think I am safe in saying that this is a low average for Empire work. I have operated the Empire drill in Colombia under most difficult conditions and in many other countries, and I would not consider this a high average. I fail to see wherein Mr. Ward's combination has any advantage over the regular equipment of the Empire drill.

Mr. Ward, in evolving his apparatus, has made the driving of the pipe as rapidly as possible his principal object, and he does not rotate the casing. In this, he fails to obtain the principal advantage of the Empire method, which is due to the rotation of the casing. This I consider a most important factor. The rotation causes the pipe to sink readily, as it keeps it loose in the ground while the weight of the pipe, platform and the men standing upon it causes it to sink. The rotation cuts a clean core of exact diameter. Mr. Ward, in driving his pipe 6 in. at a time and then drilling and pumping without any rotation whatever, misses one of the best points that I find in the Empire and only obtains the disadvantages found in the steam drill. Many of these disadvantages were clearly pointed out in an article on sampling dredging ground, that appeared in the JOURNAL of Nov. 25, 1911.

In my present work I am drilling and pumping and sinking the casing at the same time, and when occasionally I am obliged to drive the casing, I only drive 2 or 3 in. at a time. In this way I am sure of securing an exact core. The rotation of the casing aids greatly in pulling it, and if in hard, tight ground, with any depth, it is almost impossible to pull the casing without rotating it. I think the rope, as used by Mr. Ward in his drilling, is likely to cause inaccurate results, especially in deep work, as a manila rope is continually changing its length, due to atmospheric conditions and mechanical strains. The rods with the Empire drill are marked in inches and indicate at a glance the exact core, and there is no variation possible when using these. I think Mr. Ward would find that the regular pump with its jarring attachment as furnished by the makers would give far more satisfactory results than the jar as designed by him and used with the Empire drill and pump. With his apparatus he again encounters the disadvantages found in the steam drilling.

Mr. Ward speaks of clay clogging up the drill pump. I encounter tenacious clay and use the regular clay auger furnished with the outfit, and I secure excellent results. I think, too, that Mr. Ward would find a big improvement in the windlass furnished by the manufacturers. This one is equipped with a spring, which counterbalances part of the weight of the tools when in deep drilling.

Mr. Ward states that "if the two machines were set up side by side, the Keystone steam drill would drill faster than the hand drill, but the difference in cost in preliminary placer testing comes in getting the machines to their respective holes." I think that little stress should be placed upon speed or cost in placer prospecting, and that accuracy should be made the chief object in all work. Large expenditure is usually involved, and it is most important that accurate conclusions be drawn in preliminary work.

I drilled some ground at Pierce, Idaho, with the usual Empire apparatus, and this ground was afterwards dredged, the results checking within 4%. In my present work I am averaging 43 ft. per day, and only yesterday, I drilled 62 ft. I have found no need for modifying the regular equipment of the Empire drill and think often it is better to follow the method developed by those who make a special study of this work than to attempt to devise some new method of questionable value.

MILES E. LAFFERTY.

Essex, N. C., Apr. 26, 1913.

Cyaniding Low-Grade Silver Ore

The interesting description of the cyanidation of low-grade silver ore in Mexico, by Harley A. and Rush T. Sill, in the JOURNAL of Apr. 12, 1913, seems to require some additional data to demonstrate that the results are unusual. The cyaniding cost maintained, $1.78 per ton, is reasonable, no doubt, but is not unusual on Mexican silver ores. In the case mentioned, 40% of the silver is stated to be in the form of chloride, which is notably easy to dissolve in cyanide solution. The 60% of silver in sulphide form is recognized as not being necessarily difficult to dissolve, and analysis shows no particularly rebellious elements. A more complete statement of consumption of material, such as KCN, CaO and other necessaries, would be of assistance in forming an opinion of the comparative cheapness of the operation.

J. J. B.

Washington, D. C., Apr. 15, 1913.

A Plea for Cost Details

In the issue of the ENGINEERING AND MINING JOURNAL for Apr. 12, 1913, E. M. Hamilton notes the inaccuracy of precipitation figures, wherein zinc consumption is expressed in pounds of zinc used per ton of ore treated, since a varying ratio of cyanide solution and dry pulp treated may, and does, usually exist between any two cyanide plants, whose work is in comparison. Again, with solution ratios the same, there will be a difference in fine-metal content precipitated per ton of solution precipitated; negligible for gold ores, perhaps, but especially noticeable in silver ores, so that "zinc per ton of solution precipitated" does not measure precipitation efficiency.

If we accede to Mr. Hamilton's request and express zinc in terms of fine bullion produced, we still have not arrived at the ultimate efficiency ratio, which we must consider to be the ratio of the precipitating medium to the precipitable elements. There is as much need to precipitate copper in solution as gold and silver, and for a coppery solution, it is most needful that this total zinc be supplied.

If the copper content in solution is ignored in estimating zinc consumption, the figures obtained will be valueless for purposes of comparison. Furthermore, the copper content of solutions varies from week to week, and often varies independently of the gold and silver content of the pulp treated.

It is easily seen that when precipitate varies between 10 and 25% copper, dry weight, that comparison for zinc consumption between such a precipitate and a precipitate derived from a clean, or practically noncupriferous ore, cannot be upon a fine-bullion basis. Such a case would be involved in a comparison of Goldfield and Tonopah precipitates, as described in the technical press.

Refining costs are also affected by the same factor even more strongly—for example, two precipitates may both contain 80% metal; one of which contained all silver and the other, 60% silver and 20% copper.

Another marked difference is in cost of liquid fuel in smelting precipitate, which appears when we consider the element of time, that is, pounds of precipitate smelted per hour, per gallon of fuel. Thus, some of the heavy and cheaper grades of oil will smelt at a lower consumption of oil than distillate and low-grade gasoline, which cause rapid melting, but with greater expenditure of fuel. Hence, introducing the time factor, one may work in the labor costs per hour, which cannot be done if oil consumption is figured in gallons per pound of precipitate, only.

To mention only one other anomaly in metallurgical accounting, of what value is "pounds of tube-mill pebbles per ton of ore crushed"? Tube-mills are used upon classified sand, so why not use the ratio of pebbles consumed per ton of sand reground, as the percentage of sand per ton of ore treated is not uniform for any two mills.

DONALD F. IRVIN.

El Tigre, Mexico, Apr. 25, 1913.

EDITORIALS

The Anaconda Report

The Anaconda report for 1912 is a document that ought to be satisfactory to the stockholders of this company. As compared with the previous year, a greatly increased production was made coincidently with a strong copper market and the result was naturally a magnificent profit from operations. Equally encouraging are the assurances that the development of ore reserves proceeds as fast, or faster, than the extraction of ore, and that the management of the company is devoting constant attention to the improvement of mining and metallurgical methods.

Important innovations in the practice at both mines and reduction works have lately been introduced, but we are unfortunately unable to measure just what has been accomplished by means of them. In 1911 the cost of producing the copper of the company was about 9½c. per lb., crediting the operating expense with the value of the gold and silver recovered. In 1912 the copper cost, figured in the same way, was about 9.9c. per lb. This includes the charge of $1,009,453 for depreciation of plant, which charge did not appear in the statement for 1911. Allowing for this and for the higher wages that were paid in 1912, it is probable that the company obtained in the latter year material benefit from its technical economies.

Pessimism Prevails

The last six months has been a period of pessimism, which lately has been at its deepest. Nobody now has any confidence in anybody or anything. Vague fears of evil have led investors to liquidate and hoard their proceeds. This makes money tight, and that in turn produces a relaxation in business. Gloomy predictions fail successively to come to pass, but the word is handed around that things are just as bad as if they had come true, such is the pessimism.

The causes are numerous, but apparently they are to a large extent sentimental. In Europe there has been fear that all the great nations are going to war. In the United States there is fear of the reflex effect of a European war, besides which there are our own special fears respecting the forthcoming revision of the tariff; and also what is referred to as the disturbing attitude of the public toward capitalistic interests; and the increasing importunities of organized labor.

When last week ordinarily sensible persons were worried by the nonsensical talk that Japan might declare war on the United States, we came pretty nearly to a *reductio ad absurdum*. This was about on all fours with the shivers that the civilized world experienced a few weeks ago when a German airship accidentally landed on French territory.

We shall not offer any prophecies about the prospects or result of a European war. With regard to our domestic affairs, however, we shall venture to say that the main things that are now worrying people are in reality bull arguments, and before long will, no doubt, so be recognized.

The coming reduction in the tariff will produce some uncomfortable readjustments, no doubt, but on the whole it will surely be to the economic benefit of the United States, which means of course that it will improve general business.

What is referred to as the hostile attitude of the public toward capital, means simply that the public is going to have a squarer deal. Certain financiers and promoters who have heretofore hogged more than a fair share of things, naturally do not like the new order of things. The business of organizing trusts, over-capitalizing goodwill, watering stocks, playing the public in the markets, etc., will probably suffer. Public service corporations that are run on the old "public be damned" theory will probably be forever chastened. Not one of these things is going to detract from the wealth of the country. On the contrary, the elimination of abuses, unfairness, etc., will put business upon a better basis and will improve it. The changing condition is a cause for congratulation, not for despair and pessimism.

The increasing demands of organized labor, especially the railway men, portend an inevitable advance in freight rates and a continuance of the vicious circle of increasing costs, but this particular phase of the situation is hardly critical.

Experienced observers do not, indeed, discern in the present state of things any indications of an approaching crisis. The panic of 1893 followed a period of over-production, over-construction of railways, over-capitalization of industrial enterprises and agricultural depression, which had brought the country into a condition of general insolvency. The panic of 1907 followed a world-wide over-strain of credit. Neither of those conditions exists at present.

There is no doubt a demand for capital for new and necessary work that is greater than can be conveniently supplied, wherefore many renewals and extensions will no doubt have to be delayed until the world's savings furnish the wherewithal, which savings are retarded by the constantly increasing cost of living. This may be an underlying cause of the recent stringency of money and of some of the liquidation, but the pessimism that is founded on vague fears is, no doubt, much overdone.

Another Step in Cyanidation

The treatment of the extremely complex ores of the Cobalt district by cyanidation involves many problems, most of which are peculiar to the district. In view of the wide difference between these difficulties and the ones ordinarily encountered on other fields, it has seemed inevitable that the development of some special methods, adopted to this particular combination, would grow out of the practice. This prophecy has already been fulfilled. In this issue, we publish a paper by E. M. Hamilton, describing in detail the study which led to the replacing of

zinc by aluminum as a precipitant at the mill of the Nipissing Mining Co. This change is no superficial variation, of doubtful value, but is radical and far reaching, touching, in effect, extraction, regeneration of cyanide, and bullion manipulation. The results are, in fact, so beneficial that they are astonishing, and when it is considered that these improvements may apply to other ores in other districts, the importance of the development may be understood. Silver ores containing arsenic are not rare, and as zinc is the universal precipitant, the conditions may be, in less degree, similar to those at Cobalt. If aluminum can be used in other districts with the beneficial results described by Mr. Hamilton, Cobalt will have presented to the metallurgical world a development of immense importance.

Missouri Shows Us

The dinner and reception given to President Rand, of the A. I. M. E., at St. Louis, on Apr. 28, has a significance which merits the attention of the membership of the Institute. St. Louis is the central point for a large list of Institute members, who are geographically much scattered, and there have been few opportunities for them to get together. Personal acquaintanceship and mutual interest have been largely left to chance and the situation in short was typical of that which exists everywhere else, although rarely to such a degree as in the Mississippi Valley.

With the recent revival of interest in Institute affairs and the proposal to form a local section, the St. Louis members took up the situation and came to the following conclusions:

Every man realizes that as a matter of business policy it pays to have a working acquaintance with those who are engaged in his own profession or line of business, and he is always ready to spend time and money to secure this. All that it is necessary to provide is the opportunity; and a good way to begin operations is by an annual round-up for social purposes only. The detailed operations of a local section should grow naturally out of the relations established by such annual gatherings.

The St. Louis men therefore made President Rand's recent visit the occasion for a dinner at the St. Louis Club, which was one of the most successful events in the history of the Institute and has impressed everyone in that section with the advantages of getting together. They claim that the policy works like magic because of the simple fact that it gives to members, from the rank and file to those who are financially powerful, just what they most desire. At all events we commend it to the consideration of members elsewhere. Why should there not be such annual meetings at every large mining center?

Butte & Superior

The slump in the shares of the Butte & Superior company to about 26 has been one of the recent event of interest. The mine owned by this company is without doubt a good mine, which will eventually pay dividends, but according to the impartial and reliable accounts that come to us its exploitation has been sadly bungled. The bungling has been peculiarly unfortunate in that it has coincided with one of the periods of 7c. price for spelter, which occur only once in about 10 years.

We had 7c. spelter in 1912 and in 1905. Butte & Superior failed to get the benefit of market conditions in 1912 that it ought to have done and finds itself going at a good gait with spelter at only a normal price. Let no one be deceived by the idea that 5¼@5½c., St Louis, is a low price for spelter. It is simply about the average.

Sand Cement

The use of cements consisting of portland cement mixed with other fine material is becoming almost standard practice in the West for certain classes of work. Comment on the tuff cement, used for the Los Angeles aqueduct was made in the JOURNAL of Feb. 15, 1913. In several, if not all, of the latest dams of the Government reclamation projects, the bulk of the concrete is specified to be made of portland cement, reground with an equal quantity of crushed granite or other suitable rock and this product is to be used in the same ratio to the other elements of the concrete as straight portland is usually used.

This combination cement is not considered by its sponsors to be in any sense an adulterated product, but to equal in general, and in some particulars surpass the unmixed portland cement. There would seem to be an opportunity here for mining companies in certain situations to make an appreciable saving in concrete costs, as the mixed product is substantially cheaper. In remote mines, working against a heavy freight rate, the cost of cement may amount to a prohibitive figure and lime from local kilns is often substituted for a great deal of work. This is particularly true in Mexico. The added material of the combination cement needs only to be quarried, transported, usually a short distance, crushed and reground with the portland. This in settled communities costs less than half of what portland costs, the resulting product, if a 1 : 1 mixture, is made, costing about 75% of straight portland. In remote localities, the relative cost would be less, approaching 50%, since the added material does not have to stand the high freight charges. Suitable rock can usually be found close to any mine and the property is rare in which some discarded regrinding apparatus could not be rehabilitated to do the regrinding.

Nor is the remote and usually small property the only one which might take advantage of this economy. A large plant, even at a railroad center, often may have to undertake concrete work on a large scale, for foundations, buildings, walls, dams, etc. A specially constructed crushing and regrinding plant might easily justify its cost in such a situation under favorable circumstances.

The mine and smeltery production of copper in February, last, according to our statistics, was 125,697,865 lb. The refinery statistics in that month were 130,948,881 lb. The relatively low figures in each case are explained in part by the shortness of the month. Neither the smelters' nor the refiners' figures are showing any material change in the rate of production during the first half of 1913, as compared with the last half of 1912. If anything the tendency is perhaps to fall off a little.

Mining Law Revision

The Committee on Mining Law of the Mining and Metallurgical Society of America, of which H. V. Winchell is chairman, has made a report, concluding with the following recommendations:

1. The mining law should be revised, not piecemeal, but thoroughly, so as to coördinate and harmonize its various provisions.
2. Mining claims should be locatable regardless of a "discovery" and held only so long as the specified development work is performed.
3. Placer locations should be limited to deposits of loose material above solid bed rock. The locator should have a preference right to locate also any lodes developed on his placer ground.
4. A statute of limitations should establish a reasonable term of years beyond which placer patents shall be immune from attack on the ground of fraud.
5. Provision should be made for the location and working of petroleum, phosphates, rare earths, haloids and other mineral substances not specifically mentioned in the present law.
6. Full privilege of appeal to some competent court of law should be provided for in all cases of contests between rival claimants, or between a locator and the government.
7. Notices of mining locations should be so recorded as to give the fullest possible notice to the world and to all concerned.
8. The apex law should be abolished.
9. Existing titles should be reaffirmed and fully recognized and no effort should be made to create retroactive legislation.
10. For the purpose of giving the fullest consideration to the needs of every branch of the mining industry and every section of the country, it is desirable that a government commission be created by act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as a basis for the proposed mining law revision.

No action upon the report and recommendations of this committee has yet been taken by the Society.

Blowing In an Iron Blast Furnace

In discussing the paper of Mr. Sweetser, on blowing in an iron blast furnace (*Bull.* A. I. M. E., November, 1912; reprinted ENGINEERING AND MINING JOURNAL, Feb. 22, 1912); J. E. Johnson, Jr., presented the following information: There is one useful method of bringing down the gas which was not mentioned. This consists in turning steam into the downcomer, or dust catcher, before lighting the furnace, so as to form a steam cushion between the air and the gas, which prevents the possibility of an explosive mixture being formed. John W. Dougherty has a patent on this process, but Mr. Johnson believes that it is established that the process was in use elsewhere about two years before this patent was applied for. In blowing in the furnace it is good practice to speed the engine up to a considerably higher speed than one expects to use after the gas is brought down. There is at first a slow action due to the great quantity of voids in the furnace to be filled up, and the progress of the gas is slow. If the slow blowing, which is suitable for blowing in, be used from the beginning by running the engine at 50 or even 100% greater than the blowing in speed for a few minutes, the gas is brought through promptly and the danger greatly lessened. After the gas is brought down and safely lighted, the engine can be put down to its proper speed. This need not take more than 10 or 15 min. Mr. Johnson states that under these circumstances he has lighted the furnace following this practice, and the gas was down and lighted in all burners in about 10 min. from the time the blast was turned on, without a puff of any kind. He used the steam cushion and also led the gas to the far end of the flue, opening the boiler and stove burners after the first thick white gas had pushed the steam out of the opening. In connection with the stopping of the tap hole, a good plan is to build a considerable pile of clay mixed with coke or coal braize over the tap hole and extending back well into the hearth. The pipe described by Mr. Sweetser is arranged to project through this into the furnace. When the tap hole is to be opened, it is easy to drill through this soft mass to the skull, which the heat of the hearth bakes on its surface, and the bar can then be easily driven through this skull. This plan may save a great deal of trouble when it comes to opening the iron notch. The principle is the same as that of the cinder notch, which projects into the molten matter in the hearth, and is the same as the deep hole kept by the aid of the steam gun after the furnace is in operation.

Anaconda Copper Mining Co.

The report of operations of the Anaconda Copper Mining Co., of Butte, Mont., for the year ended Dec. 31, 1912, shows that the mines and reduction works operated without serious interruption, and the tonnage of ore hoisted and treated was greater and the output of copper correspondingly larger than for several years previous.

Early in the year there was a marked improvement in the price of copper, and a general feeling developed on the part of the labor organizations throughout the mining regions of the United States that a participation in the greater profits enjoyed by the companies should be granted them in the form of an increased wage scale. The company was in accord with this belief, and a three-year contract was entered into with the Butte Miners' Union, wherein it was agreed that when the monthly price of electrolytic copper is 15c. and over and under 17c., the wages of all men employed underground shall be increased 25c. above the minimum wage scale of $3.50 per day; and that when the price of copper is 17c. and over the wage scale for underground men shall be increased an additional 25c. per day, and that corresponding reductions in the increased wage scale will take place when the price of copper falls below the figures named. Similar contracts for the same period, providing for an increase of 25c. per day when the price of copper is 15c. per lb. and over, were entered into with the other classes of labor employed by the company. These contracts will expire on June 1, 1915.

MINE DEVELOPMENT

The development done during the year, in the form of drifts, crosscuts, raises, winzes and shafts amounted to 34.1 miles, and a large tonnage of ore in excess of the amount extracted was added to the reserves. The shafts of the different properties were sunk during the year to additional depths aggregating 4736 feet.

The Modoc, Anaconda, St. Lawrence, Steward and Tramway shafts were sunk to a depth corresponding to the 2800-ft. level of the High Ore mine, at which depth the new drain tunnels connecting all mines with the High Ore shaft will be established.

The developments generally have been satisfactory, but especially so in the ground tributary to the Leonard, Tramway, Badger State, West Gray, Rock, Original, Ste-

ward and Gagnon shafts. On the bottom level of the last three a continuous shoot of ore of good grade and width was developed for a length of over 2800 feet.

The 2000-ft. level of the Leonard shaft was partially developed during the year, and the showing at the deepest point thus far reached in the property was good. While the Tramway shaft has reached a depth of 2400 ft., the lowest lateral development is on the 2200-ft. level, where a fine body of ore, wider than on the level above and of equal grade, was disclosed by the crosscut.

An auxiliary shaft to the Badger State mine, known as the Emily shaft, located on the Emily claim, which had originally been sunk to a depth of 400 ft., was sunk an additional depth of 517 ft. during the year, and connection made with the 1000-ft. level of the Badger State mine. Development work has been done on the 1100-, 1300-, 1400-, 1600- and 1800-ft. levels of the Badger State mine, with good results. The mine made an average daily output of 550 tons of ore throughout the year. Sinking in the main shaft below the 1800-ft. level was started on Dec. 19. The West Gray Rock shaft was sunk to the 1600-ft. level during the year. On Dec. 10 a fire was discovered in the stopes above the 1700-ft. level of the Steward mine, but was extinguished with little loss. During the year 1913 it is proposed to start sinking the Moose shaft to a depth of 1800 ft. and to prospect the veins at greater depth. This shaft can eventually be connected with the Badger State workings.

On Aug. 29, surface work was started on the Tropic shaft, preparatory to sinking 200 ft. below the 500-ft. level, its present depth, at which point a body of ore is known to exist.

Prior to the purchase by the company of the Southern Cross mine, 20 miles from Anaconda, it had been developed through a two-compartment shaft to a depth of 300 ft., and during the year a third compartment was added to this shaft. Sinking was resumed and the shaft will be sunk to the 500-ft. level. The mine is being equipped with a new hoisting engine and ore bins, and regular shipments of ore will be made to the Washoe Smeltery at Anaconda in the present year.

While the ore from this property contains little copper, it carries gold and is in addition an aid to smelting operations at the Washoe smeltery.

The work of installing new cylinders on various hoists, preparatory to using compressed air, electrically developed, for hoisting purposes, was carried on continuously, and the main hoisting engines at the Diamond, High Ore, Original, Tramway, West Gray Rock, Mountain View, Pennsylvania and Leonard shafts were operated by compressed air, and in addition the auxiliary engines at the Green Mountain, Diamond and Tramway shafts were installed.

The main engines for the West Steward, Modoc, Mountain View air shaft, Berkeley, Badger State and West Colusa shafts, and the auxiliary hoists for the Leonard, West Colusa, Pennsylvania, Anaconda and Mountain View shafts, are now on the ground, and will be installed as rapidly as possible.

The full installation of electric pumps at the High Ore shaft was completed, and the results were satisfactory, for in addition to the economies effected, no heat is introduced into the underground workings. Electric haulage is being installed in all the mines, with success.

A system of ventilation is being perfected throughout the different properties, by the introduction of fresh air carried into the mines through shafts independent of the main working shafts, and by the installation of large exhaust fans at other shafts, by which the heated air is drawn in large volume to the surface. During the year a thorough investigation of underground sanitary conditions was made by a specially appointed commission of scientific men, whose report was most favorable, and everything is being done by the officials of the company not only to maintain this condition but to better it.

The mines of the company produced during the year 4,576,289 tons of ore and 3668 tons of precipitates, or a total of 4,579,957 tons, hoisting through 22 shafts.

The reduction works treated for all companies during the year 3,880,203 dry tons of ore and other cupriferous material at Anaconda, and 1,189,039 dry tons of ore and other cupriferous material at Great Falls. Of this, 4,486,873 tons of ore from company mines, 581,032 tons of purchased ore, and 1338 tons of precipitates and cleanings from the old works were treated, from which there was produced 222,763,670 lb. fine copper; 9,702,605 oz. silver, and 52,564 oz. gold at Anaconda; and 71,710,491 lb. of fine copper; 1,312,132 oz. silver, and 8,751 oz. gold at Great Falls; or a total production of 294,474,161 lb. of fine copper; 11,014,737 oz. silver and 61,314 oz. gold.

Washoe Smeltery

A new machine embodying improvements for concentrating with a centrifugal apparatus was built. This has been operated during the year, and while the results would indicate that upon certain classes of material the operation of the machine is satisfactory, there is still a doubt as to whether some other machine might not be of equal service. A test will be made in the near future, operating upon slime as it comes from the mill.

In the last annual report it was stated that it was the intention of the company to remodel one section of the concentrator at the Washoe reduction works, installing in place of the old system of concentration the one evolved at the Great Falls works, whereby it was expected that not only would the tonnage treated be increased, but also a material saving would be effected. This was done, and the results based upon three months' continuous operation of the remodeled section proved it to be a success.

A great amount of experimental work has been done during the year, embracing the testing out of many concentrating machines, with varying success, and also a process for the reduction of slimes and tailings, which promises well. The process will be tested on a larger scale, and should it prove successful a complete installation will be made, which will mean a reduction in costs, and an increase in output of refined copper from the same tonnage of original ore treated. The process has been perfected by employees of the company. There is available at the Washoe reduction works many millions of tons of tailings, the accumulation of years of operation, all of which would be amenable to profitable treatment by the process, should it prove successful.

Great Falls Smeltery

The Great Falls smeltery, built in the year 1889, became antiquated, and it was deemed advisable to erect a new smeltery, with the exception of the blast-furnace department, rather than to attempt to repair the old one. The erection will begin in the early part of the year 1913.

The greatest improvement made during the year was in the converting department, where a radical change was made in the size of the converter shells. The 12-ft. cylindrical converter, known as the "Great Falls type," from which excellent results were obtained, was supplanted by a converter cylindrical in shape, 20 ft. in diameter, which has been tested over a period of several months and found to give excellent results. The new smeltery will be equipped with converters of this type.

The coal mines at Belt have reached such a depth that the mining of coal cannot be carried on under economical conditions, and it is probable that this property will be closed during the year 1913. An ample supply of coal for all needs can be furnished from the mines at Diamondville and Washoe, and from independent producers. The mines at Belt, Mont., produced 82,654 tons of coal; 62,998 tons were shipped to other departments of the company; 114 tons were sold commercially, and 19,542 tons were used at the coal mines.

The mines at Diamondville, Wyo., produced 624,477 tons of coal; 340,275 tons were shipped to other departments of the company; 231,179 tons were sold commercially, and 53,023 tons were used at the coal mines.

The mines at Washoe, Mont., produced 130,684 tons of coal; 110,935 tons were shipped to other departments of the company; 13,391 tons were sold commercially, and 6358 tons were used at the coal mines.

It was considered advisable to curtail the output from the lumber mills to a slight degree until such time as some of the stock of commercial lumber could be disposed of. A marked improvement in general business occurred during the latter part of the year, and conditions generally would tend to indicate continued improvement during the coming year. The mills at all of the plants are in excellent condition, and everything is in preparation to turn out a sufficient amount of lumber to meet the demand.

The sawmills of the lumber department at Hamilton, Hope, Bonner and St. Regis cut during the year 73,541,349 ft. of lumber, and 43,360,629 ft. were purchased. There were 76,621,345 ft. shipped to the mines of the company; 54,189,160 ft. were sold commercially; 1,044,856 ft. were used at the mills for repairs and construction, 5,452,086 ft. were supplied to the factory, and 65,560 ft. were shipped to agencies; or a total disposition of 137,373,007 ft., decreasing the stock of finished lumber on hand by 20,471,029 ft. The subsidiary departments of the company show for the year profits of $308,346.

Good progress was made during the year in the electrification of the Butte, Anaconda & Pacific Ry. from the mines at Butte to the reduction works at Anaconda, and the road should be in full operation some time during 1913.

On Nov. 1, 1912, the Georgetown extension of the Butte, Anaconda & Pacific Ry. was completed. Steam locomotives will be used in operating this extension, as it is not considered that there will be a sufficient volume of business to warrant electrification, at least for the present.

The railway transported during the year 5,715,540 tons of ore and freight, and 265,829 passengers. The gross earnings were $1,259,170, and rental of tracks and miscellaneous receipts $22,136; operating expenses, $1,090,703; taxes, interest and rental on leased lines, $86,170; net income, $104,433. A dividend of $30,000 was paid, leaving a surplus profit for the year of $74,433. The company also declared a stock dividend of $1,500,000.

The fixed assets of the company, including mines, claims, water rights, townsite property, buildings and machinery, timber lands and investments in sundry companies amount to $96,577,795. The deferred assets, including insurance and other expenses paid in advance and material and supplies for future use, sum up $3,104,644. Current assets, merchandise, copper and other metals on hand, accounts receivable and cash together make $25,395,411, a total for all assets of $125,077,851. The liabilities are for capital stock, $108,312,500; current, including wages, taxes and dividend warrants not presented, together with the dividend No. 49 of Jan 15, 1913, reach $8,070,178.

The surplus consists of the balance of Dec. 31, 1911, $2,905,087, plus stock dividend from the Butte, Anaconda & Pacific Ry. Co., $765,000, and plus the year's profit, $15,856,334, making a total of $19,526,422. From this there is to be deducted dividends Nos. 46, 47, 48 and 49, $10,831,250, leaving the net surplus, $8,695,172.

California Quicksilver in 1912

An advance chapter of the 1912 report of the California State Mining Bureau gives the quicksilver production of the state in 1912 at 20,600 flasks, as compared with a 1911 production of 19,109 flasks. The average price per flask of 75 lb. in 1912 was $42.04; in 1911, $46.01 per flask. The increase in production was 7.8%; the decrease in total value was 1.5%. The above are final figures.

Eight counties reported production in 1912 as follows: San Benito, 9743 flasks; Santa Clara, 8695; San Luis Obispo, 666; Sonoma, 646; Fresno, 336; Napa, 287; Lake, 209; Trinity, 18. Nine counties reported production in 1911. Twelve counties in which there are quicksilver mines, made no production during the year.

Chuquicamata

This property is said to have developed 100,000,000 tons of ore averaging 2.5% copper, and there is possibly 100,000,000 tons more ore to be developed. The ore is to be mined by steam-shoveling and treated by leaching with dilute sulphuric acid and electrolytic precipitation.

The Chile Copper Co., owning the property, is capitalized at $110,000,000, divided into shares of $25 par value, stock to the amount of $15,000,000 being reserved for conversion of the bonds that are to be issued. The bonds are to be a first mortgage, and are to pay 7% interest, and are to be convertible into stock at par.

The Filter Litigation

Moves are still being made in the filter dispute between Moore and Butters. On Jan. 13 last the Moore Filter Co. sued the Butters Patent Vacuum Filter Co., asking an injunction against all infringers of the Moore process patent. This case came up before Judge Mayer, of the United States District Court, in the Southern District of New York, on May 1, and the judge denied the complainant's motion. The meaning of the decision, in effect, is that a general injunction cannot be granted but decisions will have to be given by local courts where the alleged infringements are taking place.

PERSONALS

A. W. Newberry is now with the Canadian Copper Co. at Copper Cliff, Ontario.

Martin Schwerin's present address is care of the Pan-American Chamber of Commerce, 42 Broadway, New York.

E. G. Spilsbury has gone to Colorado and Arizona on professional business, which will occupy his about two months.

Robert E. Cranston arrived at San Francisco recently from London, and left Apr. 30 for Colombia, on professional business.

George L. Kerr has been chosen secretary of the Mining Institute of Scotland, in place of James Barrowman, resigned.

Charles E. Schwarz has been appointed superintendent of the North American Smelting Co., with office at Perth Road, Ontario.

S. F. Shaw, superintendent for the American Smelting & Refining Co. at the Tiro General mine, Charcas, Mexico, is in New York City.

A. L. Queneau, consulting engineer, of Philadelphia, is still at Jemeppe sur Meuse, Belgium, and expects to remain there for some time longer.

R. C. Gemmell has become general manager of the Utah Copper Co., succeeding D. C. Jackling, who is now vice-president and managing director.

Louis D. Huntoon has become eastern representative of the Stearns-Roger Manufacturing Co., of Denver, Colo., with office at 115 Broadway. Mr. Huntoon will also continue his consulting practice.

Henry H. Armstead, president of the Mexican United Co., has returned to New York from Mexico, where he has been engaged for several months making an inspection of the company's properties.

F. W. Monnish, president of the Tuscaloosa Coal & Iron Co., Tuscaloosa, Ala., has been appointed by Governor O'Neal a member from Alabama of the American commission to study rural credits in Europe.

B. G. Slaughter, Jr., has been made vice-president of the Canadian Copper Co. to succeed Captain John Lawson, who was recently made president. Mr. Slaughter was formerly mechanical superintendent for the company.

John P. Cosgro, manager of Mine & Smelter Supply Co., in Mexico, has just arrived in New York from Mexico, having come here for medical treatment at the Neurological Institute. His friends will be glad to hear that the physicians predict his early restoration to complete health.

Guilford D. Scholl, who was formerly with the U. S. Metals Refining Co., at Chrome, N. J., has accepted the position of assistant superintendent of the Electrolytic Refining & Smelting Co., of Australia, Ltd., and will sail from San Francisco on May 28 for Port Kembla, New South Wales.

Carmi Thompson has been appointed by the trustees of the Great Northern Ore Properties general superintendent of those properties. He will have his office in Duluth, Minn., and will make arrangements for the handling of those properties when the leases to the Steel Corporation are concluded.

OBITUARY

Isaiah Townsend Burden died Apr. 23 at his home in New York, aged 75 years. He was born in Troy, N. Y., and was a son of Henry Burden, the inventor of machinery for making horseshoes. He was educated in the common schools of Troy and at Russell's Academy, at New Haven, Conn., and began his business career as a partner in Henry Burden & Sons, at Troy, manufacturers of bar iron, horseshoes and rivets. In 1881, with his brother, James A. Burden, he organized the Burden Iron Co., in which he held a half interest, to take over the business of Henry Burden & Sons, their father having died. He was once president of the Port Henry Iron Ore Co., and at the time of his death was a trustee of the Lake Champlain & Moriah Ry. Co., and a director of the Burden Iron Co. He was one of the organizers of the Knickerbocker Trust Co., New York. He was a member of several clubs. Besides his widow, he leaves a son and two daughters.

Judge Moses Hallet, a pioneer of Colorado and famous as a mining judge, died at his home in Denver, Apr. 25. He was born in Galena, Ill., July 16, 1834. After studying law in Chicago he was admitted to the bar in 1858 and established himself in Galena, but the gold fever brought him to the Clear Creek and Gilpin mining camps of Colorado in 1860, where he actively engaged in mining. In 1863 and in 1865 he was appointed to his first official position as a member of the Territorial Council and was made chief justice of the Supreme Court of Colorado by the President of the United States, May 1, 1866, serving until 1876. He was then appointed U. S. district judge, and held this position until he resigned May 1, 1906, rounding out 40 years' service on the bench. Nine-tenths of the big lawsuits involving mines worth millions of dollars, were tried before Judge Hallet, and his wonderful knowledge of mining law enabled him to settle many cases satisfactorily. As Federal judge during the troublous days of the mining camps he set an example to the state courts for obtaining justice in mining transactions, and was a powerful factor in making Colorado a law-abiding state. When he left the bench seven years ago it was truthfully said that he had handed down more opinions on mining matters than any other judge in the world. The sole survivor of the immediate family is Lucius Felt Hallet, about 26 years old, who is an electrical engineer in Boston. Judge Hallet left a large estate.

SOCIETIES

American Institute of Mining Engineers—The St. Louis members and some from the territory adjacent held a meeting at the St. Louis Club, Apr. 28, to consider the formation of a local chapter. President Rand and Secretary Stoughton were present as guests. Ex-governor of Missouri D. R. Francis, Captain Robert W. Hunt and others were also guests at the dinner and made addresses. Ex-governor Francis gave an address of welcome, followed by Mr. Rand, who spoke on the present condition and the future of the Institute; and by Captain Hunt, who related some of the achievements of the past, when Dr. Raymond was at the head of affairs. Several other members and guests made informal addresses and then every one of the 20 and more members who were present spoke to the question of the desirability of forming a local section. It was thereupon moved and unanimously resolved to form such a section and a Committee of Arrangements was appointed, consisting of Philip N. Moore, Chairman; F. V. Desloge, H. A. Guess, W. E. McCourt, H. H. Stoek and H. A. Wheeler.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

COPPER MATTE—Method of and Apparatus for Bessemerizing Copper Matte. Howard B. Jernee, Perth Amboy, N. J. (U. S. No. 1,059,367; Apr. 22, 1913.)

REFINING—Process for Treating Copper. David Wesley Blair, New York, N. Y., assignor, by mesne assignments, to Metallurgical Research Co., New York, N. Y. (U. S. No. 1,058,941; Apr. 15, 1913.)

AMALGAMATING CONCENTRATOR. Lee Cannaday, Park City, Utah. (U. S. No. 1,059,436; Apr. 22, 1913.)

AMALGAMATOR — Hydraulic Amalgamator. Robert L. Brown and Joseph M. Brown, Los Angeles, Calif. (U. S. No. 1,059,524; Apr. 22, 1913.)

SEPARATOR—Mitts Quenner, Santa Ana, Sonora, Mexico, assignor, by mesne assignments, to Quenner Dry Crusher Co., Douglas, Ariz. (U. S. No. 1,059,068; Apr. 15, 1913.)

BRIQUETTES—Process of Manufacturing Briquettes from Ore or Blast-Furnace Dust. Wilhelm Haage, Walsum-on-the-Rhine, Germany, assignor to the Firm of Gewerkschaft Pionier, Walsum-on-the-Rhine, Germany. (U. S. No. 1,059,150; Apr. 15, 1913.)

ELECTRIC FURNACE. Ernesto Stassano, Turin, Italy. (U. S. No. 1,059,499; Apr. 22, 1913.)

MALLEABLE IRON—Process for the Production of Malleable Iron Direct from Ore. Axel Rudolf Lindblad, Ludvika, Sweden. (U. S. No. 1,058,991; Apr. 15, 1913.)

REFINING—Improved Apparatus for the Electrolytic Refining of Iron. G. Tischenko, St. Petersburg, Russia. (Brit. No. 5885 of 1912.)

ZINC—Process for Reducing Zinc Oxides. Charles F. Burgess, Madison, Wis. (U. S. No. 1,059,342; Apr. 22, 1913.)

POTASH—Process of Refining Potash-Bearing Brines. C. E. Dolbear, Berkeley, Calif., assignor to Frank H. Hitchcock, Washington, D. C. (U. S. No. 1,058,684; Apr. 8, 1913.)

EDITORIAL CORRESPONDENCE

SAN FRANCISCO—Apr. 30

The Gold Dredge Tailing Piles in California Are an Asset on which the future restoration and reclamation of agricultural lands may be undertaken. When there is a demand for the lands now used for dredging to be made available for agriculture they will be restored or reclaimed. The burden of the restoration of the land, including as it must in most fields the improvement of the streams, should not, and could not lawfully, be placed alone on the dredging operators or owners of the lands. The ratio of increase in assessed valuation of the dredging lands in the Calaveras fields may be applied to other fields in the state. So it may be fairly estimated that the 11,000 acres of proved lands available for dredging have increased in taxable value from a total of $55,000 to $1,045,000. When the dredging is done the taxable value reverts to the original figure of $5 per acre, and it would be no greater if the land were actually restored to its original condition, unless the improvement of the streams was included in the restoration, for in most of the fields the agricultural value of the lands that are available for dredging depends largely upon the condition of the streams. The improvement of the streams cannot be put upon the dredging companies unless the operations interfere with or damage the channel or stream bed. The ultimate restoration of dredging lands should, and will, if common sense and fairness influence legislation, be borne by the landowners, the counties and the state, and will include the straightening and deepening of stream channels, the preventing of floods and the conservation of water for agricultural and power purposes.

The Water Commission Act, which will in all probability become a law, is considered by many to be a violation of the rights of the people to the use of the waters of California, and an indirect assault upon the mining industry. The water commission is to be composed of five members at salaries of $5000 per annum each; three members to be appointed by the governor. An appropriation of $150,000 is made for the use of the commission. The commission is authorized to appoint a secretary and such expert, technical, professional and clerical assistance as it may deem proper, and fix the compensation of all employees. All water which has not been appropriated, or which may have been appropriated but not in use from the date of appropriation in proportion to the magnitude of the work necessary to properly utilize it for the purpose sought, is declared to be unappropriated. If any portion of the waters of any stream shall not be put to use on lands riparian to such stream for a continuous period of five consecutive years after the passage of this act, and unless otherwise appropriated for use on other than lands riparian, such waters are declared to be in the use of the state and subject to appropriation in accordance with the provisions of this act. If the users of water do not develop the stream to such capacity as the commission may deem to be required by the public good the joint use by others may be permitted by the commission to the full capacity of the stream or to such capacity as the commission may deem advisable. The development of water for the generation of electric or other power is especially attacked. Such use of water will be allowed only by permit of the commission upon application and payment of fees provided for. For each theoretical horsepower up to 100 hp. capable of being developed by the proposed works the fee is $2.50 per hp. with a minimum total fee of $25. For each theoretical horsepower above 100 and to and including 10,000 hp. the minimum fee is $500. For above 10,000 hp. the minimum fee is $1000. For use other than the generation of electric or other power, the fee is $10. At th time of receiving license to the use of water the applicant shall pay then and annually thereafter, a charge of 25c. for each theoretical horsepower capable of being developed by the proposed works. All uses of water except under lawful appropriation made prior to this act except by individuals for domestic purposes, unless permitted by the commission, shall be deemed a misdemeanor, for which a penalty is provided. The commission has power to make investigations as to the relative rights of various claimants to water. Fearing that some of the provisions of the act may be held by the courts to be unconstitutional, the makers of the act have provided for the members of the commission by declaring that such finding of the courts as to any particular sections shall not invalidate the other sections. The only users of water who are not tied up by this act are the farmers.

DENVER—May 2

Cripple Creek's Output for April shows a slight decrease in tonnage and an increase of about $30,000 from last month's figures. The following figures are given by the managers of the different plants, treating Cripple Creek ore; being tonnage and gross value respectively: Portland, Colorado City, 10,000 tons, $220,000; Portland, Cripple Creek district, 14,100 tons, $47,517; Stratton's Independence, 11,384 tons, $29,143; Ajax, 4368 tons, $13,322; Cavanagh, 1900 tons, $3990, Gaylord, 1500 tons, $4500; Wild Horse, 1300 tons, $4160; Isabella, 800 tons, $1600; Smelters, 3600 tons, $234,000; Golden Cycle, 31,800 tons, $636,000; total, 80,752 tons worth $1,194,232.

Camp Bird Has Brought Suit Against Frank W. Howbert, internal-revenue collector, through its attorneys, Thomas, Bryant & Walburn, to recover $35,850, claiming this amount to be excess tax collected under the corporation tax law of the United States. The company claims that ore extracted from the mine each year should be treated as depreciation and the company be given credit for it. Moreover, it contends that 25% of the net income paid each year to the estate of the late Thomas Walsh should be charged to expenses and not net income. This claim made first to the collector was not accepted and the commissioner being appealed to, held to the same ruling as the collector, saying that this payment was part of the company's capital. The refund asked covers the years 1909, 1910 and 1911. The price paid by the English company for the property was $3,200,000, of which $2,000,000 was in cash and the rest in the annual payments of 25% of each year's net income from the mine, which is approximately $1,500,000. A similar suit brought in the federal court by Stratton's Independence, Ltd., was decided against the company and is pending in the U. S. Supreme Court, to which it was appealed.

BUTTE—Apr. 30

The Pipestone Reservoir Irrigation Co., organized by Whitehall men for the purpose of damming Pipestone Creek in Jefferson County, and thereby irrigating a large acreage of bench land near Whitehall, has begun work upon the project. Excavation has been started for the dam which will be near the headwaters of Pipestone Creek, and will, when completed, have a capacity for impounding sufficient water to irrigate more than 5000 acres of land which heretofore has been useless on account of the lack of water.

The Holdings of the Anaconda Copper Mining Co. include the majority of the mines in Butte, and the company is the largest owner of coal lands in the state, and with the exception of the Government, is the largest owner of agricultural and timber lands. The company recently added to its posessions by purchasing all of the Northern Pacific holdings in Lincoln County, and the northwest portion of the state, consisting of 145,294 acres of timber and agricultural land, for which $408,222 was paid.

A Result of the Closing of the Bradley Plant, at Anaconda, Apr. 22, was that 55 men were thrown out of employment. The plant was built two years ago at a cost of nearly $250,000, for the purpose of treating the slimes from the Washoe concentrator, to save the small percentage of copper, gold and silver, contained therein. The financing was done by the Copper Extraction Co., composed of Eastern men, among whom were Charles S. Bradley, Thomas W. Lawson, A. C. Burrage and others.

SALT LAKE CITY—May 1

Shipments from Park City for the First Four Months of 1913 amounted to 27,645 tons, divided as follows: January, 6672 tons; February, 8038 tons; March, 5733, and April, 7202 tons. During the same period Tintic shipped 3084 cars, or a monthly average of about 770 cars. The April output was 734 cars, and there were 23 shippers.

An Appropriation for Measuring the Flow of Streams has recently been made by the state legislature, and this work has been begun under the direction of W. D. Beers, state engineer. The Federal Government is coöperating in the work, and Mr. Beers recently visited sites for various stations.

NEGAUNEE—May 2

The Unusual Size of the Sherwood Exploration orebody is bringing the operation of this subsidiary of the Republic Iron & Steel Co., into prominence. In addition to the original 80-acre tract, the 20 acres known as the Aronson, and 60 acres known as the Minckler, have been secured, making 160 acres. It is reported that the orebody is estimated at 10,000,000 tons. The location is one mile north of Iron River, which section has been boomed lately.

The Mastodon Find of the Nevada Land Co., in the Crystal Falls district, will be mined partly as opencuts. Pickands, Mather & Co., which has taken over a portion of the find, plans to strip the ore lying nearest to surface, and will probably mine several million tons by opencuts. Opencut mines are rare on the western Menominee range. A new channel will be dug for Mastodon Creek, and ground will soon be cleared for a mine location. Both the Chicago & Northwestern Ry. and the Chicago, Milwaukee & St. Paul Ry. plan extensions into the Mastodon district.

A Miners' Club Has Been Formed in the Iron River district, the members consisting of mining officials and mining men interested in safety and rescue work. The formation of the club comes as a sequel to the visit of the Bureau of Mines rescue car to the district. The purpose is "to promote efficiency, welfare and safety in and about mines; the exchange of ideas, plans and data among the members of the club; and the perpetuation of mine-rescue work and first aid to the injured." The president of the club is G. L. Woodworth, manager of mines of the Rogers-Brown interests in Michigan. This is evidence of how deeply the first-aid craze has taken root on the Michigan iron ranges.

Strikes Have Been the Subject of Much Thought both in the iron and copper regions, due to the agitation by labor federations and to the general scarcity of labor which makes strike conditions possible. In the Iron River district the Western Federation has been working for a foothold for some time. On the Marquette range there are several Socialist organizations composed mostly of Finlanders. In regard to the possible calling of a strike in the Michigan mining districts, mine operators are recalling the fizzle in which the Mesabi range strike ended in 1907. This lasted several months during which the mines closed down. Many parades of striking miners were held, several men were killed, but that effort of the Western Federation was a failure.

Iron-Ore Shipping Has Begun in the Crystal Falls District and three steam-shovels are at work at stockpiles, at the Crystal Falls mine, at the Armenia, and at the Ravenna. The Crystal Falls and Armenia are old mines of Corrigan, McKinney & Co. The ore at the Crystal Falls has been in stock since 1907, the Armenia is a nearly exhausted mine. The Ravenna is a new mine of M. A. Hanna & Co., just out of the exploration stage; 18,000 tons was forwarded last year and 25,000 tons is on stockpile. The Bristol mine, of Oglebay, Norton & Co., is shipping about 35 cars per day from the shaft, and the Dunn and Tobin, of Corrigan, McKinney & Co., are also shipping their daily hoists. The stockpile of the Mansfield mine, of the Oliver Iron Mining Co., now idle, will be shipped during the season.

ST. LOUIS, MO.—May 1

The Internal Troubles of the St. Joseph Lead Co. have again attracted attention by the publication of another letter by Robert Holmes, copies of which were mailed to each stockholder. Mr. Holmes is actively canvassing for proxies to try to wrest control from the present management at the annual meeting, May 15. There is considerable difference of opinion in local circles as to the merits of Mr. Holmes' attack, especially as he was defeated in the suit he instituted in New York to oust the present officers, and in view of the past successful record of the company. The question of the consolidation of the St. Joseph and Doe Run lead companies will also come up at this meeting, and as many of the stockholders hold stock of both companies, it will probably carry, as it will permit of many economies in the administration. A committee has been appointed from each company to consider the matter, which has just spent a week at Bonne Terre with J. R. Finlay.

PIOCHE, NEV.—Apr. 29

Many Prospectors Have Gone Into Willow Springs District, in Nye County, during the last month, because of reports of a big strike there. The principal strike was made last year, at a place now called Hundred Mile Camp, on account of being about 100 miles from Pioche, Ely and Tonopah, by two Lincoln County prospectors, Charles Lampson and David Jenkins. After shipping about $30,000 worth of ore from a 30-ft. hole, these men sold a half interest to Tonopah men, who did no further work until after purchasing the other half about one month ago. The consideration is said to be $40,000, the locators retaining an interest in the ore on the dump. Shipments will soon commence via Tonopah, at a cost for hauling of $40 per ton. The ore will average better than $200 per ton. The country rock is limestone and shale, and the vein in the limestone is from 14 in. to 3 ft. wide, the principal valuable mineral being native silver. Lessees working about 500 ft. above the shaft have encountered the same vein. About 1½ miles north of Hundred Mile Camp, a prospect hole in the shale at the junction of two veins gave an assay on a 4-in. streak of $1000 in gold and 2600 oz. silver, but it is claimed that the locator is afraid to put another shot in the vein lest it will disappear. There are about 35 people in the district, and, although most of the ground in the immediate vicinity of the two strikes is located, there is still good ground for prospecting.

TORONTO—May 3

The Appropriation for the Mint at Ottawa has been increased from $75,000 to $110,000, with the object of providing facilities for refining all the gold produced in Canada, instead of sending it to New York. Hon. W. T. White, Finance Minister, stated that 105,000 oz. were refined at the mint in 1912, the value of gold bars sold to jewelry manufacturers and banks being $296,000.

The Project to Extend the Bruce Mines & Algomah R.R. to the Transcontinental R.R. has been financed in England and work will be started at once. The present road is 10 miles long extending from Bruce Mines on Lake Huron to Bruce on the "Soo" branch of the Canadian Pacific and beyond to the Rock Lake copper mine. It is proposed to continue this road northeasterly to Ridout on the main line of the Canadian Pacific passing through the Mississaga forest reserve and crossing several iron and copper areas. The road projected then crosses the Woman River iron field which it will open for operation and extend northeasterly along the Groundhog valley to the Transcontinental line now being constructed, which it reaches at a point about 12 miles west of the Groundhog River crossing. The road will open much unknown territory in a part of Ontario that is hardly prospected. The recent gold discoveries in the Groundhog River district near the Transcontinental line are attracting attention because of the richness of the samples which were brought out last autumn and this new road will open a wide extent of the formation in which the gold is found in the Groundhog region and elsewhere in Ontario. H. Appleton, of Sault Ste. Marie, Mich., is largely interested in the railroad, which will be known as the Lake Huron & Northern Ontario Railway.

COBALT—May 3

Two Important Meetings of the Western Federation of Miners were held by the Cobalt branch, Apr. 27, to discuss the bearing the eight-hour day would have on labor. Various amendments to the act were suggested and it was put to a vote whether the union should declare a strike on May 1. At both the meetings, the resolution to strike was voted down and it is stated that there was a majority against the resolution of 11 votes. A two-thirds vote in favor of the strike is necessary before the men can be called out. The action of the Cobalt branch will have an important bearing on other camps throughout the district. The ill success of the strike throughout the Porcupine camp seems to have made the agitators more determined than before and it is believed that continued efforts will be made to incite the Cobalt miners and precipitate labor troubles. It is also believed that the union is making a particularly strong effort to organize the Sudbury field, where, heretofore, they have been unsuccessful.

Indications Point to a Boom in the Kirkland Lake District during the coming season. While the number of promising discoveries has been so far, limited, and there is only one producing mine in this district, there is a strong feeling of optimism regarding the possibilities for future development. The Burnside property, which adjoins the Foster-Tough has been purchased by the Aladdin Cobalt Mining Co., an English enterprise. While this is lauded as signifying the entrance of important English capital in the Kirkland Lake district, it is believed that the mining operations of this company will be largely directed through the stock ticker. The company's action in connection with the taking over of the Silver Queen, the flotation of the Aladdin Cobalt stock in England and the acquiring of the Chambers-Ferland property, is open to criticism and the stock is at present selling on the English market at a greatly inflated value. It appears, however, that there is a promising strip of land between Kirkland Lake and Larder Lake, and during the coming season, this is bound to come in for attention and there are good prospects of discovering other valuable properties.

THE MINING NEWS

ALASKA

Chandlar District

ACTIVITY IN LODE MINING is reported from the Chandlar district. The isolation of the camp and the difficulty in transporting supplies and machinery has greatly hindered development work. Three years ago a three stamp mill was purchased for the property of the Titusville Mining Co., but it was found that it would be impossible to freight it to the mine until a large amount of work was done on the trail from Fort Yukon to Chandlar. A boiler and hoist were recently landed on the property and development work will be hastened. There are several other properties that have shown good prospects, and most of these are being developed on a small scale. On the First Chance and the Last Chance claims a 5-ft. vein has been disclosed by trenching. An adit is now being driven to tap the vein at a depth of 140 ft. The Chandlar Mining & Development C., controlling a group of claims, has let a contract for driving 400 ft. of tunnel.

Copper River District

DAN CREEK MINING CO.—The plant on this hydraulic property, which was destroyed by high water last summer, at a loss of approximately $50,000, is being rebuilt.

TARAL DEVELOPMENT CO.—Turbines and other equipment for developing hydro-electric power, as well as much mining machinery has been purchased. The vein is from 8 to 32 ft. wide. Dr. B. F. Whiting, of Seattle, is president.

KENNECOTT MINES CO.—The loading station at the mouth of the Bonanza tunnel, destroyed by fire last winter, has been rebuilt, also that part of the tramway destroyed at the same time. The Jumbo tunnel is showing up so well that a compressor will soon be installed. Several years ago some engineers predicted that the Jumbo tunnel would enter an orebody similar to that encountered in the Bonanza tunnel, and development work now indicates that the prediction will be fulfilled.

MOTHER LODE COPPER MINING CO.—Litigation having been settled, systematic development of this property has begun. The initial work includes a tramway 6600 ft. long from the upper to the lower terminal with a drop of 3000 ft., which will place the ore on a wagon road on McCarthy Creek, for transportation to the Copper River & Northwestern Ry. George E. Baldwin, the engineer in charge, states that the company expects to have the machinery installed so that the mine can operate by fall and ship ore next winter.

Fairbanks District

REXALL—This mine has been closed on account of a shortage of ore.

SPALDING—A recent cleanup from ore taken from the workings of the lessees on the Soo claim yielded 192 oz. of bullion, valued at $3275. The lack of water has prevented steady operation of the mill.

RHOADS-HALL—A station has been cut at the 140-ft. level of the winze and crosscuts are being driven to the vein. The mill, which could not be operated continuously for several months, is now receiving sufficient ore.

FORD & POMEROY—The adit is in about 300 ft., and a raise has been started. The ore has not been of satisfactory grade for the last 150 ft., and if better ore is not found soon operations will probably be discontinued.

CRITES & FELDMAN—The adit has been driven 260 ft., the vein being about 14 in. wide at the face and the grade of ore being excellent. A millrun on 20 tons of the better ore taken out in driving the adit will be made at the Willis mill, on Chatham Creek.

RAINBOW—A Straub mill is being installed on this property in Skoogy Gulch. There are several hundred tons of ore on the dump and sufficient stoping ground has been opened to keep the mill in continuous operation for a time. No difficulty is expected in obtaining plenty of water from the creek for both summer and winter work.

HUDSON BROS.—Seven stopes have been opened on two of the smaller veins on this Ester Creek property, and it was planned to place the two-stamp Nissen mill in operation about May 1. A larger vein, about 12 ft. wide, has been developed also, but only enough ore will be taken from this to supply the deficiency in case the other veins are unable to keep the mill busy.

HOMESTAKE—The vein on this claim, which adjoins the Rexall, has averaged 18 in. in width for 150 ft. in the adit. Two millruns have been made on the ore taken out in driving the adit; the first, a 28-ton lot crushed at the Newsboy mill, yielded $77 per ton in gold, while the second lot, of 18 tons, yielded $170 per ton. A raise showed that the vein narrowed to a streak within a few feet of the roof of the adit.

TEDDY R.—The lessees, George Wheeler and Rex Ford, have put several men to work stoping ore from the shoot near the entrance to the tunnel. Test runs of this ore have shown it to mill about $25 per ton. The Little Giant mill at the head of Fairbanks Creek has been leased, and it is expected to have a shipment of 400 tons ready by June 1. Driving of the adit has been discontinued until the vein can be trenched on the surface.

NEWSBOY—At a recent meeting of the stockholders, most of whom are Fairbanks business men, it was decided to place $15,000 worth of treasury stock on the market to raise funds for sinking the shaft to the 500-ft. level and do exploratory work. Besides the 5-stamp mill on Cleary Creek, the equipment of the mine includes an air compressor, drills and hoist. The shaft has been sunk and timbered to a depth of 340 ft. and stations have been cut at depths of 115, 215 and 315 ft. At each of these levels and also at the 60-ft., drifting and other exploratory work has been done. Considerable ore has been stoped, the gross production of the mine having been about $30,000. The vein is well defined and has averaged about 5 ft. in width, but no continuous oreshoot has been developed, the ore occurring in irregular, isolated bunches. Louis Golden is manager.

Juneau District

ALASKA MEXICAN—In March, 20,139 tons of ore were crushed, yielding $38,570 or $1.93 per ton; $12,378 being net profit.

ALASKA UNITED—In the Ready Bullion mill, 18,396 tons of ore yielded $41,652, or $2.28 per ton; the net profit for March being $15,777. In the 700-Ft. Claim mill, 20,685 tons of ore yielded $55,671, or $2.71 per ton; $28,320 being net profit.

ARIZONA

Graham County

NEW ENGLAND—Much development work is being done on these copper claims, recently acquired by Phelps, Dodge interests. The tramway is being reconstructed.

Pima County

SAN XAVIER—The Empire Zinc Co. is shipping about 1000 tons of carbonate ore monthly from the old workings.

DOUBLE O—J. T. O'Hara and R. O. Boykin have sold the mine, near Amado, to a Los Angeles syndicate, which will continue development.

Pinal County

ARIZONA-AJAX—The property is being equipped with a 15-hp. hoist, compressor and drills. The vein of lead, zinc and copper ore is 22 ft. wide.

YANKEE GIRL—Sinking the shaft from the 100- to the 500-ft. level has been begun. Rich gold-silver-copper ore has been shipped in the past to the smelter at El Paso. The work is being done under the direction of Mr. Guild, manager of the Tortolitas Copper Mining Co.

Santa Cruz County

SILVER CANYON—Richard McCardle is now getting out high-grade silver ore and hopes to ship by the carload in a short time.

HARRISON—Recent development through the lower tunnel, which has been driven 300 ft., shows exceptionally good silver-copper ore.

R. R. R.—This bonanza is still shipping 100 tons per day and the plan for increasing this daily tonnage has been postponed until prices are a little better.

ROSARIO—J. M. Hackett is shipping from this mine on Salero Hill. While the shipment is small the ore is high grade, the silver occurring mostly as native silver.

RED ROCK—This group is to be examined for the Calumet & Arizona company. The deposit is a large outcrop of low-grade copper ore about nine miles from Patagonia

NEIGHBOR—This group of prospects taken over by the Copper Queen, is showing well under development. The vein is thought to be an extension of the World's Fair vein.

AUSTERLITZ—Dr. A. H. Noon has commenced suit against Layne & Woodworth for the restitution of this mine in the Oro Blanco district, alleging failure to comply with the terms of bond and lease.

DELAWARE—Mr. Pulliam, who developed and sold the Philadelphia mine in southwestern Chihuahua, is negotiating for a lease on this mine from Hogan & McCutcheon, the present owners. The mine is in Josephine Cañon.

BUENA VENTURA—A group of claims surrounding the old Mills claim at Live-for-Ever spring, has been investigated and it is announced by the owners that substantial work will be done on the vein by Albuquerque men.

HAVALINE MINING CO.—This company, operating the Santo Niño mines, in the Patagonia district, near the international boundary, southwest of Duquesne, has started a crosscut tunnel to the ore. The tunnel will be 800 ft. long.

MAMMOTH—On this group recently bonded to Clement Guion, of New York, by Richardson, Crepin & Schultz, work has been commenced on a shaft. The vein is an extension of the old Montezuma vein, which has produced high-grade ore.

TRENCH—Work has been suspended on the old shaft as it was found, when the water was pumped out, to be caved and in dangerous condition. A new shaft has been started on another part of the claim, where the surface showing is even more promising.

CHIEF—This mine was taken on bond some time ago by men interested in the Tigre mine in Sonora, Mexico, and considerable work has been done recently. A conference between the buyers and the sellers was held and a small payment was made. Whether this was fn full or not has not been publicly announced.

FOUR METALS—The company has been reorganized, the property and business having been taken over by a new company known as the Red Mountain Mining Co.; Oscar Tarner is manager. A new camp is to be established at Guajalote Flats and the mines will be operated on a large scale. The plans include the erection of a power plant and concentrator.

FREEMAN—This mine in the Agua Caliente Cañon has been leased by Boykin & O'Hara, and prior to Apr. 1, 10 cars of silver-lead ore were shipped. This ore assays about 40% lead and 7 oz. silver and at prevailing prices nets the lessees about $20 per ton. The ore is shipped from the Nogales-Tucson R.R. at Chavis station.

Yavapai County

PLACERITAS—A Los Angeles syndicate is operating this old mine.

BEST FRIEND—The contract for the new shaft has been let to Charles Reese & Co.

MAJESTIC IDOL—The affairs of this company have been satisfactorily adjusted and it is reported that work will be resumed shortly.

VERDE VALLEY OIL CO.—The latest reports from the field state that oil in commercial quantity has been determined at a depth of 1105 feet.

COPPER HILL—The shaft is being unwatered in order to make more extensive examination by the engineers representing the Commercial Mining Co.

SWASTIKA—The new find on the 300-ft. level is said to be yielding the richest ore yet taken from the mine. The ore is clean galena; some of it assays nearly 2000 oz. silver per ton.

CLEOPATRA—Recently ore has been found on the apex of the mountain and a quantity has been shipped from an open cut 30 ft. wide by 60 ft. long. The Hull tunnel will tap this ore at a depth of 900 feet.

SUNFLOWER—The deposit of cinnabar recently discovered in the Mazatzal Mountains, about 80 miles northeast of Phœnix, is being opened. A company has been formed to operate the property and build reduction works.

TIGER GOLD CO.—This property was recently bid in at sheriff's sale by the mortgagee. It is understood that he will work the property. His plan is to prospect systematically below the 600-ft. level, and if results are satisfactory the property will be fully equipped and operated on a much larger scale than before.

ETTA—Plans are being made for systematic exploitation of this old property. A new camp is being established and improvements made in the equipment. This is one of the old-time gold producers, and while being operated under lease at intervals during late years, has yielded considerable profit. The property is now owned by Richard DeKuhn, of Cherry Creek.

Yuma County

BIG EYE—The well sunk in the gulch, about one mile from the present campsite, has solved the water problem. A flow at the rate of 2000 gal. per day was struck at a depth of eight feet.

CALIFORNIA

Amador County

SOUTH EUREKA—A rich strike is reported on the 1800-ft. level in the south drift, driven to connect with the Oneida. It is believed to be the extension of the Oneida vein.

CLINTON CONSOLIDATED—The property of this mining company was advertised for sale for delinquent state taxes. Charles S. Wieland secured a restraining order on the ground that he is willing to pay the amount, $6111, which includes taxes dating back to 1892. The Union and Paugh mines are part of the property.

Calaveras County

HARDY-McCREIGHT—A new shoot of ore is reported. Telephone connection with Angels Camp, a distance of four miles, has been made.

INGOMAR—After extensive development on the 300-ft. level, sinking of the shaft to the 500 was started, the shaft now being about 400 ft. deep. George C. Graves, of Campo Seco, is manager.

UTICA—Seven miles of flume which carries water for mining and domestic use will be rebuilt. The main flume is about six miles long and extends from Stanislaus River near the Big Trees to Angels Camp. It will be 7 ft. wide and 4 ft. deep. The flume will carry approximately 3000 miners' inches of water in 24 hours.

LIGHTNER—A suit has been brought in the superior court against the Lightner Gold Mining Co., which was answered by the appearance in court of the Lightner Mining Co., the former owner and operator. The suit is by the Manuel Estate Co. for supplies furnished the defendant of record. The Lightner Gold Mining Co. purchased the property in 1911 and has made one payment of $50,000; another $50,000 is said to be due Apr. 1. The total price is reported at $200,000. Whether the second payment will be made or not is not made known. The new company has expended about $200,000 in development. The three-compartment shaft was deepened 1000 ft., and when the mill was shut down in the last half of 1912, there was indication of finding good ore. The 60-stamp mill treated a large amount of ore in 1911 and 1912. It is reported that if the new company does not complete its purchase contract, the original owners will again undertake the operation of the mine. The old company is said to have levied an assessment of 5c. per share for the payment of state taxes.

Colorado County

LIVINGSTONE—This mine in Slug Gulch is being reopened.

PLACERVILLE GOLD MINING CO.—Notice of foreclosure sale has been given by this company.

Imperial County

IMPERIAL & EL CENTRO—This syndicate has located 640 acres of land containing gypsum, lime and clay deposits, about 25 miles northwest of the San Diego & Arizona Ry.

Inyo County

SKIDOO—The pipe line carrying water from Jail Cañon at the foot of Telescope Peak, which burst during cold weather in January, is being repaired. The 20-stamp mill will resume operation as soon as the repairs are completed.

Kern County

GOOD HOPE—The new 7500-gal. water tank has been installed to supply the mill.

YELLOW ASTER—A dividend of $5000 was declared Mar. 28, making the total dividends $1,151,789. Work was recently begun on the top of Yellow Aster Mountain 400 ft. above the open pit. About 600 tons of ore and waste are broken down daily and moved to the chutes with three one-horse carts. From the chutes the ore is loaded into cars and hauled by locomotives to the mills; the waste is handled the same way. The 30-stamp mill is closed down temporarily awaiting the installation of a new air compressor to displace the one employed to operate the air-lift pump, which proved inadequate. The 100-stamp mill is running steadily. This mill is supplied with water from the Goler wells; the smaller mill gets water from the Old wells station.

Madera County

TEXAS FLAT MINES CO.—At this mine, at Coarse Gold, the shaft is below the 1200-ft. level. Medium-grade ore is being mined from the drift on the 1000-ft. level, and is crushed in the electrically driven 20-stamp mill.

ENTERPRISE—Five stamps of the reconstructed 10-stamp mill began dropping on ore in the first week of April. The ore is hauled in wagons from the mine, at Grubgulch, to the mill, a distance of half a mile. The mill, crusher and compressor are driven by water power, from Fresno River.

MADERA CONSOLIDATED GOLD MINING CO.—The Gambetta mine, at Grubgulch, is being developed on the 400-ft. level. Two steam-driven Huntington mills have been installed. Oil is the fuel used. The old three-compartment shaft has been repaired, and a new concrete collar, 60 ft. deep, has been built. A new shaft has been started about 1500 ft. from the old one.

Mariposa County

CALHOUN—Ore will be hauled to Le Grande and shipped by Santa Fé Ry. to Selby.

WHITE GULCH MINING CO.—A new hoist and compressor will be installed at the Virginia mine, near Coulterville.

MERCED MINING CO.—The Melvina mine has been unwatered and preparations are being made for building an aërial tramway.

WHITE ROCK—The ore from this mine in the Green Mountain district is hauled by auto trucks to Le Grande and shipped to the Selby smeltery.

COPPER QUEEN—This mine in the Green Mountain district is being developed under lease. A new shaft has been sunk to a depth of 25 ft., and the ore is being raised by a horse whim. A drift has been started on the vein at the 100-ft. level.

POCAHONTAS—This copper mine, in the Green Mountain or Ben Hur district, shipped 11 carloads of ore to Selby in February. The ore is hauled by two 6-ton auto trucks to Le Grande, Merced County, and there loaded on Santa Fé cars. The mine hoist is operated by steam, slack coal being burned.

PEARCE—This copper mine, owned by J. B. Pearce, is shipping ore to the Mammoth smeltery, at Kennett. The ore is sacked and hauled by wagon to Raymond, Madera County, on the Southern Pacific R.R.. The rail freight is $4 per ton. The mine is developed by a 125-ft. shaft and a 400-ft. tunnel. A winze is being sunk on the vein at the breast of the tunnel. The ore is sulphide beneath 60 to 100 ft. of gossan. The copper content is reported to be as high as 20%. The mine is in the Green Mountain district.

Mono County

HALL GOLD MINING CO.—The 10-stamp mill at the Golden Gate mine in Antelope valley is crushing about 40 tons of ore per day. A two-bucket tram carries the ore from mine to mill, a distance of one-quarter mile.

Nevada County

CHAMPION—It is reported that the North Star Mines Co. has decided to purchase the mine. Development during the two years that the North Star operated the mine under purchase bond, includes 9000 ft. of work underground and a cyanide plant for treating the ore crushed by 20 stamps of the old mill. The Merrifield vein has been developed on the 1600-ft. level and the Ural vein on the 2400-ft. level.

Placer County

POVERTY BAR DREDGE—This dredge is being built on Poverty Bar, near Butcher Ranch. It will be equipped with 3½-cu.ft. buckets, revolving screen, nozzle washers and the Holmes type of gold-saving tables. Poverty Bar is one of a series of bars in the middle fork of American River, which was hydraulicked and sluiced from 1848 to 1860. The bars have been prospected with Keystone drills within the last year and shown to be rich in gold. The dredge is designed by George L. Holmes, of San Francisco, and is being built and will be operated by the Eldorado & Placer Counties Gold Mining & Power Co.; A. Tregidgo, manager.

San Benito County

PACIFIC QUICKSILVER CO.—The furnaces are in operation and ore of good grade is being mined at this mine near Panoche. Some new machinery is being installed. A. F. Eaton is superintendent.

Sierra County

TIGHTNER—It is reported that several thousand dollars worth of specimen ore was recently stolen. This ore is kept in a vault at the breast of the main adit level, which is securely locked. The lock was picked while the "graveyard shift" was at work in the stopes 1000 ft. distant.

Trinity County

SLIDE CREEK PLACERS—This property, recently purchased from William Martin by N. L. Tenner, of Orange Grove, N. J., is being examined by H. P. Gordon, to decide upon building a ditch line and flume. The property is near Denny, on New River.

COLORADO

Clear Creek County

TOBIN—This property is being developed by Johnson & Co., lessees.

GENEVA—This property on Alpine Mountain is being developed by William Alfred, the owner.

STANLEY—During April the fifth level west heading was advanced 85 ft. to a total length of 2136 feet.

NATIONAL—Development of this West Argentine property will be resumed in the near future. Edwin Clark is manager.

BELLMAN—The winze from the Big Five tunnel level has been sunk 100 ft. in pay ore. From the bottom of the winze drifts will now be advanced each way.

BURLEIGH TUNNEL—Development in the winze below the tunnel level has been resumed by Lyons & Co., lessees. Drifting is in progress on lead-zinc ore.

GAMBETTA—The results of recent development have been favorable, and it is reported that shipments of zinc ore will soon be resumed. B. J. O'Connell, of Georgetown, is manager.

WALDORF MILL—It is reported that this mill is to be completely remodeled during the next 90 days. The so called Edison method of concentration is to be adopted.

CAPITAL—The new boring equipment, which will be used to sink a 10-in. ventilating hole on the Aetna vein a distance of 1100 ft. to connect with the lower mine workings, is on the ground.

GLADSTONE—Lessees are developing this property with favorable results. During the last month additional pay ore has been opened and shipments will be increased. C. L. Jaynes, of Idaho Springs, is manager.

ONANDAGA — This company will install a compressor plant at Georgetown. The machinery will be placed in a new building to be erected near the Capital mine. The company controls the Ruler and Comet properties.

BURNS-MOORE MINING & TUNNEL CO.—This company's entire property on Chicago Creek, including 44 lode claims, tunnel site, mill site, water rights, buildings and machinery, was to be offered for sale at Idaho Springs, Apr. 28, to satisfy a judgment amounting to $5526.

BARD CREEK MINING CO.—This company is shipping from its property on Lincoln Mountain. Recent development has opened pay ore in the upper levels. The lower crosscut tunnel will be driven with machine drills. It is reported that the company will soon consider the construction of a 50-ton concentrating mill. Frank Nelson is manager.

IDAHO-BRIDE—A strike is reported in the west drift on the Newhouse tunnel level. The total width of the vein is 3 ft. The milling ore will be shipped to the Argo mill. The heading will be advanced to cut the Bride vein, which will then be developed by drifts and a raise to connect with the winze which is being sunk on the vein from the level of the Idaho tunnel.

HOLLINGSHEAD—At this property on Albro Mountain near Dumont, an 18-in. vein of rich silver-lead ore has recently been developed in a new prospecting adit. Fine specimens of wire silver are obtained. The shoot was struck about 60 ft. from the portal of the adit and is exposed for a distance of 15 ft. The discovery has caused renewed activity in prospecting on the south slope of Albro Mountain.

NORTH AMERICAN SMELTER & MINES CO.—A strike made in the old Donaldson, operated by this company, has caused considerable excitement in Idaho Springs. The ore was found 1100 ft. below surface in the 400-ft. drift west above the main Rockford tunnel. The streak is 2½ in. wide and some of this ore assays $7000 per ton. The find was made 600 ft. below the old shaft workings.

SMUGGLER—A rich silver discovery is reported in this mine above Silver Plume. The discovery was made on the fourth level east heading and is almost under the bed of Clear Creek. The shoot is opened for a distance of about 100 ft. The mine is owned by the Hollingsworth Mining Co., of which A. E. Simpson is manager. The shaft was recently sunk 100 ft. to a total depth of 475 ft. The four upper levels are producing pay ore. The bottom level station has been cut and drifting will soon be in progress.

BIG FIVE—A contract has been let for the erection of an ore-treatment plant of 250 tons capacity, near the portal of the Central tunnel, ground for which is leased by the company for 50 years with the option of buying the plant at the end of the first 10 years or any 5-year period thereafter, construction to be commenced not later than September and the plant to be in operation within one year from that date. Edison improved crushing machinery will be installde. A plant will also be erected at Silver Plume. If that is successful, the contract for the erection of a plant at Idaho Springs will be let.

ROCKFORD TUNNEL—The Centurian and Rockford properties on Donaldson Mountain are being operated through this crosscut tunnel by the Rockford Leasing Co., of which John Larson is manager. Development and stoping are in progress at a point about 3000 ft. from the portal of the tunnel. A shoot of smelting ore 12 in. wide is exposed for a distance of several hundred feet. Regular shipments of ore assaying $30 per ton are made to the smelter. Special lots have recently assayed as high as 2 oz. gold and 300 oz. silver per ton. The company contemplates more extensive operations in the near future.

DORIT MINING, MILLING, TUNNEL & TRANSPORTATION CO.—Ground has been broken for a new 60-ton mill for the treatment of the ores of this Chicago Creek property. The company will endeavor to have the plant in operation within 60 days. The John A. Traylor Machinery Co., of Denver has been awarded the contract for grading, construction of the building and furnishing of all machinery and equipment. The building will cover an area 50x80 ft. The process will include amalgamation and concentration. Lane mills will be installed for grinding and amalgamating. The Dorit tunnel, which is 1400 ft. long, has intersected four veins of low-grade ore. The veins are from 4 to 5 ft. wide and assay about $6 per ton in gold.

Gilpin County

LOTUS—This property, which includes a large group of claims on Quartz Hill, along the line of the Newhouse tunnel, is being developed and operated by lessees.

Pueblo County

COLORADO FUEL & IRON CO.—It is reported that a concentrator for treating low-grade ore from the Sunrise mine will be built at the Minnequa steel plant. The plant is to cost $40,000 and will be completed next fall.

San Juan Region

ROUND MOUNTAIN SMELTERY — Manager Kraemer states that the furnaces will be blown in about May 15.

PRIMOS CHEMICAL CO.—The mill at Newmire is now operated by electric power supplied by the Western Colorado Power Co. The capacity of the mill has recently been doubled.

JUNTA CONSOLIDATED—Work has been started on the new 300-ton cyanide plant on Bear Creek, near Telluride. Sliming of all the ore and filtration will be features of the process. Justin H. Haynes is superintendent.

BUTTERFLY-TERRIBLE—This property near Ophir Loop is being operated by John B. Olson under lease. Development is in progress in the lower levels of the mine and the mill is being overhauled and placed in working order.

CIMARRON—Development has been in progress during the winter. Some additional equipment will be installed in the mill, which will be overhauled and placed in working order by the time the water supply is sufficient for operating.

WESTERN COLORADO POWER CO.—This is the new name of the power company which has been operating recently under the name of the Utah Power & Light Co. It is a consolidation of the three companies formerly known as the Telluride Power Co., the Animas Power Co. and the San Juan Water & Power Co.

TOMBOY—The expense of handling concentrate has been reduced by the installation of several special cars which receive the concentrate directly from the bins at the mill, haul it over the surface tram to the upper terminal of the wire-rope tramway at the Ophir tunnel and load it into the tramway buckets which take it to the Pandora loading station. The new method of transportation eliminates the cost of sacks and sacking, and saves time. Middlings from the Wilfley tables are reground in Hardinge mills, classified in Richards hindered-settling classifiers, and passed to Deister slime tables. These tables are especially adapted for the treatment of this product and are doing satisfactory work.

Teller County-Cripple Creek

A DREDGE HAS BEEN ORDERED TO WORK PLACER GROUND AT THE BASE OF MINERAL HILL, which was bought by T. J. Moynahan in the early days of Cripple Creek.

C. K. & N.—From the discovery on the fourth level two shipments have been made. A car of screenings brought $99 per ton, while the coarse rock sold for $70.

BLUE FLAG—According to the recently issued report of the company, the average cost per ton of ore mined is $2.258, and for milling $1.663, a total cost of $3.921 per ton.

IDAHO

Lemhi County

TWO NEW GOLD DREDGES ARE BEING BUILT on Kirtly Creek, near Salmon City, which will be operated by electric power from the Salmon City Light & Power Co.

ABOUT 80 CARLOADS OF HIGH-GRADE SILVER-LEAD ORE is being hauled monthly over the Pittsburgh & Gilmore R.R. from the mines at Gilmore, the ore going to the smelters at Salt Lake and Butte.

YUBA CONSTRUCTION CO.—This company is building a dredge at Bohannon Bar, a large force of men being employed to promptly complete the work.

GOLD RIDGE—The stockholders recently had the property examined and as a result have reorganized the company and refinanced it. Operations will be started this spring. A 10-stamp mill and modern cyanide plant have been erected. The oreshoots are large and opened up for 1400 ft.; the average recovery is about $4.50 per ton. The vein is developed for more than two miles by the Gold Ridge, Gold Flint and Gold Dust companies.

MICHIGAN

Iron

HOMER—The shaft, which has been sunk through overburden for several months, has reached bedrock.

MC GREEVY STEEL CO.—The shaft at the Purcell is 215 ft. deep and drifting for the first level has been started.

BENGAL—A steel headframe is nearly completed at this mine of the Verona Mining Co. In the new engine house an electric compressor has been installed.

YOUNGS—This mine, in the Iron River district, operated by the Huron Mining Co., is temporarily closed down, due to difficulties with the sales agents, the Lake Erie Ore Co.

JONES & LAUGHLIN—As has been the case for several years, this company will conserve its Lake Superior iron ores, making only moderate shipments, and will purchase in excess of 1,000,000 tons.

PRINCETON—At the power plant of the Cleveland-Cliffs Iron Co. at this mine, in the Gwinn district, the big steam-driven air compressor was badly wrecked, Apr. 20, by an explosion due to the relief valves failing to work.

SEC. 21—This mine, of the Oliver Iron Mining Co., at Winthrop, is being allowed to fill with water. The property has been idle for several years, but has been kept pumped out.

The pumps will be left underground as the deterioration will be small. The mine contains a fair sized orebody that will be mined when the company needs the ore.

CORRIGAN, MCKINNEY & CO.—This company, one of the largest operators in the Crystal Falls district, is reported to have taken over a 40-acre tract of the Michigan Iron & Land Co., adjacent to and northwest of its Dunn mine. It is thought the Dunn orebody, now nearly exhausted, continues across the line, and if exploration encounters ore it will be mined from the Dunn workings.

CLEVELAND IRON MINING CO.—This corporation, one of the oldest on the Michigan iron ranges, has filed articles of association, renewing its incorporation for 30 years. The company organized in 1849 was included with the Jackson Iron Co., Iron Cliffs Co. and Pioneer Iron Co. in the consolidation to form the Cleveland-Cliffs Iron Co., and the latter company owns all but nine of the 100,000 shares of the Cleveland Iron Mining Co., par value $25 each. The mines of the Cleveland Iron Mining Co. are at Ishpeming.

CLEVELAND-CLIFFS IRON CO.—Electrification of this company's mines, in the Marquette and Swanzy districts is progressing. Electric hoist and compressor have recently been received at the Cliffs Shafts mine, in Ishpeming. It is not probable that the steam hoist at the Lake mine will be replaced with electric hoist, as this steam plant is a notably efficient one. The Maas mine, in Negaunee, will also retain some of its steam machinery, and the elaborate steam turbines there will be retained in condition for auxiliary work. The following of the company's mines on the Marquette range now have electric-haulage systems underground: Lake, Cliffs Shafts, Maas, and Negaunee. The speed of electric locomotives underground has been limited to eight miles per hour. The company has practically completed the installation of safety devices as recommended by its safety department; all gears, belting and moving parts of machinery have been safeguarded, as have all shafts and raises underground; a system of electric signal lights has been devised and placed at all track connections and turnouts in the underground haulage lines.

MINNESOTA

Mesabi Range

GREAT NORTHERN—It has been announced that the trustees of the Great Northern iron ore properties would make public May 7, the sixth annual report, in which they tell of preparations for continuing the mining and sale of ore after the expiration of the Steel Corporation's lease. In anticipation of the Government's monopoly suit, the Steel Corporation took advantage of a provision in its lease to serve notice of an intention to cancel it Dec. 31, 1914. The trustees received in 1912, $2,637,797 as dividends on stocks of the Allouez Bay Dock Co., the Duluth, Superior & Western Terminal Co., the Leonard Iron Mining Co., and the North Star Mining Co. As interest it received $66,355, making a total income of $2,704,152 for the year. Expenses consumed $73,171 and a dividend on the certificates of 50c. each required $750,000, leaving an excess of receipts over disbursements of $1,880,980. The balance of undistributed income at the end of the year was $3,453,053. The Great Western Mining Co., the Steel Corporation's ore subsidiary, has now completely absorbed the credits which it had for deficiency minimum royalties paid in 1909 and 1910. In 1913 it is called upon to pay royalties on 5,250,000 tons. Mine development carried on by the trustees will make it possible to mine and sell some ore this year, a larger amount in 1914, and an increasing output thereafter. Engineers have reported to the trustees that the expenditure of about $7,700,000 will make available 18,000,000 tons of ore in the various mines.

MONTANA

Butte District

PILOT-BUTTE—The shaft has reached a depth of 70 ft. below the 2000-ft. level, and station cutting on that level is underway preparatory to crosscutting north and south to the veins. It is probable that a station will be cut and crosscutting started on the 1800-ft. level also. Construction of orebins and a spur line to connect with Butte, Anaconda & Pacific R.R. is underway and the management expects to begin ore shipments in June. Steel for the construction of a new boiler house has been ordered.

ANACONDA—As a result of an accident to the main hoisting engine at the Badger State mine the property was recently closed down for 10 days. During this time shaft sinking in the main shaft was continued by the auxiliary or chippy hoisting engine, which operates in a third compartment of the shaft. The hoist at the Emily shaft was also kept running for the convenience of the pumpmen, and for lowering supplies and timber. Repairs to the engine have now been completed and the usual tonnage is being hoisted again.

Lincoln County

BRICK & BRANAGAN—Development work has been in progress during the last winter at this property, in the West Fisher district, about 35 miles south of Libby. A tunnel is being driven to crosscut the vein. The property is equipped with a 10-stamp mill that has not been operated for several years because of internal troubles in the company. Because of these troubles the mine has been leased.

KALISPELL-LINCOLN GOLD MINING CO.—Plans are being made for building a 5-stamp mill on the property in the West Fisher district, to replace the 3-stamp mill which was built last summer. Heavier stamps are to be put in. Several test runs were made with the small mill last year and the returns in gold were so satisfactory that it has been decided to install the heavier and more expensive equipment at once. S. F. Ralston will probably be manager. It is claimed that the ore from this mine assays about $50 per ton in gold, but the vein is not wide.

HAZEL T. MINING CO.—This company, operating the Shaughnessy Hill claims, has made a deal whereby the Buzz Saw, one of the main claims in the group, will be purchased by the company, which gives it ownership of all the principal claims on the vein. The company will probably take steps in the near future toward the erection of a concentrator. Development work has been in progress most of the time since the company became interested in the group, more than one year ago, and the vein of silver-lead ore has been crosscut by a tunnel at a depth of 500 ft. and drifts have been driven. The showing is said to be good. The property is eight miles south of Libby and is reached by a good wagon road.

NEVADA

Clark County

SANTA FE—It is reported that this company, operating near Searchlight, will erect a 10-stamp mill at once.

RAND—A recent cave in the main shaft of this property, situated in the Eldorado Cañon district, disclosed gold ore of good grade. It is stated that the old mill will be put in shape.

MILFORD—The crosscut in the hanging wall on the 100 level has opened a 6-ft. vein of lead-carbonate ore, averaging 50% lead. The management is contemplating the installation of a new gasoline hoisting plant. R. W. Moore is in charge.

BULLION—The new hoisting plant and aërial tramway are in operation, and two cars of lead-carbonate ore have been shipped since Apr. 1. The mine force has been increased and a steady production will be maintained. The ore is hauled by wagon seven miles to Jean.

SOUTH NEVADA—This company's property is eight miles southeast of Las Vegas, and orders have been placed for the equipment of a 100-ton mill, which will be erected immediately. It is reported that a large tonnage of ore is developed, containing $30 in gold and occurring in a 5-ft. vein between limestone and quartzite. The mill is to be equipped with rolls, stamps and a cyanide annex to treat the tailing from amalgamation.

POTOSI—This property, formerly controlled by the Mahoney Brothers, of San Francisco, has been sold to J. B. Jenson and associates, of Salt Lake City. The property is the oldest in the district, and in it are three miles of underground workings. The ore is zinc carbonate, carrying some lead, with limestone gangue and a considerable tonnage is now blocked in the mine. Being situated 20 miles from the railroad, plans are being made to effect cheaper transportation than haulage by wagons, formerly used, and a narrow-gage spur 12 miles long to tap the Yellow Pine branch near Goodsprings, is contemplated.

YELLOW PINE—The new oreshoot on the second level is being opened rapidly, and it is estimated that 5000 tons of ore have been blocked out in the last month. The ore averages 20 ft. in thickness, and has been followed along the strike for 75 ft. In March, the mill treated 2100 tons of ore. Several improvements in the mill, including the enlargement of ore-bins and the installation of a filter plant to treat the slimes, of which 20 tons per day are produced, are contemplated. The steam-power plant will also be replaced by a 100-hp. gas engine, using "tops" or low-grade distillate as fuel. The company has declared its usual monthly dividend of 2c. per share, payable Apr. 25.

Elko County

MINERAL MOUNTAIN MINING CO.—A gasoline hoist has been installed at the No. 1 shaft. Two drifts are being driven from the 350-ft. level. One of these will be driven under the old silver-lead workings from which much high-grade ore was shipped in the '60s by theShanley, an English company. Good silver-lead ore on the quartzite foot wall is being encountered in the other drift. Silver-lead ore assaying about $30 per ton is being followed by the No. 2 shaft. This ore is being followed toward the granite contact, and is on the main vein of the district on which is situated the Tecoma, Black Warrior, and Salt Lake Copper Co. properties.

Eureka County

BUCKHORN MINES CO.—A 350-ton mill and cyanide plant is being built at Buckhorn, and during the summer a power plant will be built at Beowawe, Nevada, for generating electric power, and a transmission line 30 miles long will be constructed, connecting the plant with the mill at Buckhorn. S. J. Kidder is general manager.

Humboldt County

CASE LEASE—This lease on Block 6, of the Crown Hills, shipped its first car of ore. The vein is 2 ft. wide and the ore is high-grade silver.

ROCHESTER-WEAVER—This company is now stoping 4 ft. of ore that assays about $100. A second shoot 5 ft. wide, assaying $50 per ton, has been opened recently. Joseph F. Nenzel is president.

COLLIGAN LEASE—A gold discovery was made in Rochester on this property, operated by the Rochester Nugget Mining Co.; $45 ore has been opened, $25 of which is in gold. The mine is on the south slope of Nenzel Mountain.

ROCHESTER MILL & REDUCTION CO.—This company, incorporated for $500,000, has announced plans to commence at once the construction of a 50-ton mill in Rochester Cañon. The mill will consist of a 10-stamp Nissen unit, the stamps to weigh 1850 lb., crusher, concentrating tables, tube mill, and cyanide plant. Grading on the millsite is to begin soon.

Lyon County

PINE GROVE—Supplies for grading for the mill at Pine Grove were recently shipped from Yerington. The Truckee River Power Co. will extend its line to Pine Grove in the near future.

BLUE JAY—Ore is being shipped from development. The crosscut on the 100-ft. level has been driven through a shoot of good copper ore, and this crosscut is expected to strike the main orebody in a short distance.

MASON VALLEY MINES CO.—During the week ended Apr. 24, ore was received as follows: From Mason Valley mines, 2732 tons; Nevada-Douglas, 1780 and other mines, 533; total 5045. Nine carloads of matte were shipped.

NORTHERN LIGHT COPPER CO.—This company, operating a mine southeast of Yerington, has just shipped a car of ore which contained 16.4% copper. There is a good showing as far as developed, and considerable shipping will be done this summer. The mine has made a big production in the past. The chief disadvantage is the long wagon haul. D. W. McKenzie is the lessee.

Mineral County

DEL MONTE CONSOLIDATED MINING & REDUCTION CO.—A promising copper strike has been developed to a depth of about 100 ft., the ore assaying 8% copper, and $2 in gold and $4 in silver per ton. The ore seems to be in a fissure vein between limestone and porphyry. The "Julia ore belt" is also being developed, the ore containing gold and silver and some lead. This belt has been developed to a depth of 200 ft. at the deepest place, and several cars of ore have been shipped which yielded from $25 to $85 per ton. A test run on 1000 tons of low-grade ore from this portion of the property resulted in 65% recovery being made, but the test plant was not provided with cyaniding equipment. The company is now contemplating the addition to its plant of a complete cyanide annex, classifying, agitating and filtering, probably with the Oliver filters.

NEVADA NEW MINES CO.—About 35 men are employed at the mine and mill of this company. In the mine, development is the chief work being done. The 10-stamp mill is now treating 25 tons of ore per day, that assays $25 per ton. An extraction of 92% is claimed. The ore carries a large percentage of silver, so that the bullion averages $1.50 per oz., with silver at 58c. The mill contains 10 stamps, one 6-ft. Hardinge mill, two Trent agitators, two Dorr thickeners, Akins classifier and Oliver filter. The addition of an agitator and thickening tanks to do more decanting and eventually do away with filtering, is contemplated. Ore is being taken from two shafts. One of these is 275 ft., and the other 500 ft. deep. A crosscut was driven from the 500-ft. level, a distance of 240 ft., at which place it cut the vein that has been worked from the surface to the bottom of the 275-ft. shaft. This vein has been drifted on for a distance of more than 50 ft. to the north and 150 ft. to the south, and has shown milling ore for the whole distance. The drift is still being driven each way, machine drills being used. A raise has been started that will connect with the drift from the bottom of the 275-ft. shaft and a winze will soon be started on the vein below the 500-ft. level. This will be sunk about 75 ft., and if the ore proves satisfactory, the main shaft will probably be sunk to the 650-ft. level, and a crosscut be driven to the vein. The equipment includes two 25-hp. Western gasoline hoists, one 45-hp. Alamo gasoline engine, one 10x12-in. compressor, and one 8x8-in. compressor; three machine drills are being operated. The mine is equipped with telephones, and there is a telephone from the mine to the mill. Four sets of lessees are working in the company's grounds, and three are shipping ore steadily, but not in large quantities.

Nye County

HALIFAX TONOPAH MINING CO.—Recent improvements consist of the installation of a 300-hp., double drum, Wellman-Seaver-Morgan hoist, driven by a General Electric motor with magnetic control. Another 20¼x12¼x12 Ingersoll-Sargent, two-stage, motor driven compressor has been installed, there being two of these machines now installed, exact duplicates and driven by 100-hp. motors. To the transformer equipment of three 100-kw. Bullock transformers, three 50-kw. Westinghouse transformers have been added for the mine pumps. On the 1400-ft. level one Worthington, geared, triplex pump, of 125 gal. per min. capacity against 800-ft. head has been installed. This pump is equipped with a 40-hp. Westinghouse motor. In the bottom of the shaft a No. 7 Cameron sinker is in operation and on the 1000-ft. level two Gould, geared, triplex pumps, with a capacity of 100 gal. per min against 1000-ft. head, are being installed. Each is equipped with a 50-hp. Westinghouse motor. On the 1400-ft. level, what is considered to be the Belmont vein was recently cut, but owing to a flow of water which was cut at the time of cutting the vein, crosscutting has not been continued, and will not be resumed until the completion of the installation of the pumps. The shaft is being sunk to 1700-ft. level, where it is the intention to cut a station large enough for station pumps and then to crosscut to the Belmont vein. The 1700-ft. level should be reached in about six weeks. At present all water is being raised with a 600-gal. bailer.

SHIPMENTS in tons from Tonopah mines for the month of March were as follows:

Tonopah Mining	14,712	North Star	....
Tonopah Belmont	13,519	Mizpah Extension	25
Montana-Tonopah	4,559	Jim Butler	1,923
Tonopah Extension	4,696	Tonopah Merger	325
West End	4,475		
Midway	350	Total	47,008
MacNamara	2,424		

Washoe County

WARNER—About 80 tons of ore was recently shipped from this mine near Peavine Peak, 14 miles north of Reno. The shaft at this property is 100 ft. deep, cutting the vein on the dip about 160 ft. below the outcrop.

RED METALS—This property in the Granite district, near Peavine Peak, is producing small quantities of ore, said to be worth about $150 per ton.

NEW MEXICO

Colfax County

GOLDEN AJAX—In December 1912, operating on accumulated mill tailings was started with a special type of tube mill made for the company in Denver, and also a 15-ft. Paterson hydraulic agitator that had been recently installed. The results have been so satisfactory that the company has decided to operate the mine and install three additional agitators of the same type. The mine is now being put in condition for operation as soon as the changes are completed at the mill.

NEW YORK

St. Lawrence County

BENSON MINES ORE CO.—This company controlled by Pilling & Crane, Philadelphia, operating magnetite mines at Benson Mines, N. Y., plans to erect a new high dam on the Oswegatchie River above the present dam and power house for controlling the drift ice which has bothered operations during the winter.

NORTHERN ORE CO.—This zinc company operating at Edwards, is making arrangements to purchase electrical power from the Watertown power company which has a hydro-electric plant on the Oswegatchie River at South Edwards, five miles to the southeast. Shipment of concentrates has not begun yet but will start within a few weeks.

INTERNATIONAL PULP CO.—At talc mine No. 2½ the new concrete power house has been completed and a large belt-driven air compressor installed which will furnish air to all the company's mines at Talcville, replacing the plant destroyed by fire last summer. A new duplex, geared hoist has also been installed, and the hoisting cable will be taken across the river on sheave stands.

UTAH

Juab County

TINTIC SHIPMENTS for the week ended Apr. 25 amounted to 187 cars.

SELMA—This company is preparing to sink the shaft from the 210-ft. level.

LOWER MAMMOTH—A car of zinc ore of unusually good grade was shipped the week ended Apr. 25.

GRAND CENTRAL—Copper ore is being mined from the 2380-ft. level, where drifting is in progress both to the north and south. So far the ore has occurred in bunches, but there are indications that a larger shoot of ore will be found.

GOLD CHAIN—The greater part of the present output, 36 cars during April, is coming from the Ajax vein. Drifting is in progress to the southeast from the tunnel level, the object being to develop another vein paralleling the Ajax, and extending through the property.

CHIEF CONSOLIDATED—Returns are stated to be considerably in excess of dividend requirements. The lower levels are being worked, and new developments are looked for on the 1600. Connections between this property and the Gemini are being made, the work being carried on from both sides. It is thought these will be completed within a month or six weeks.

MAMMOTH—Shipments for January, February, March and April amounted to 206 cars, the ore at present coming chiefly from between the 600- and 1000-ft. levels. The oxidized zone extends below the 2000-ft. level, and so far little water has been encountered. The total production of this mine amounts to about $10,000,000, and dividends amounting to $2,250,000 have been paid. The last was paid in October, 1912, after an intermission of 4½ years, and amounted to $60,000, or 15c. per share.

IRON BLOSSOM—A winze has been sunk on the vein to the 700-ft. level, where drifting both to the north and south is in progress. The face of the south drift is in quartz mineralized with silver, and there is copper in the foot and hanging wall. Copper ore is being mined from the No. 1 workings, coming chiefly from the 600- and 700-ft. levels. There is a good showing of ore of this character on the 1100-ft. level also. April shipments from the mine amounted to 174 cars. A dividend of $100,000 has just been paid.

Salt Lake County

COLUMBUS EXTENSION—What is thought to be the Toledo vein, has been cut.

UTAH CONSOLIDATED—Earnings during 1912 are reported at $2.01 per share, as compared to $1.46 in 1911.

OHIO COPPER—The mill is reported to be treating from 2700 to 2800 tons of ore daily. The production during March was 68,000 tons.

UTAH METAL—This company's 11,494-ft. tunnel across the Oquirrh range connecting Tooele and Bingham is about 300 ft. within completion. A statement to stockholders has just been issued. A daily flow of water, varying according to the season from 600,000 to 800,000 gal. has been developed, and the sale of this water is being negotiated. A contract for a considerable part of it has practically been closed. The property owned by the company is favorably situated, with producing mines on various sides. Since June 15, 1912, veins of ore have been cut, ranging from a few inches up to 2 ft., in width.

Summit County

PARK CITY SHIPMENTS for the week ended Apr. 25 amounted to 4,090,140 pounds.

THOMPSON-QUINCY—A strike of high-grade silver-lead ore was made recently in raising on the fissure toward the contact, and the face shows 10 ft. of ore. The work is 225 ft. above the 900-ft. level of the Daly West.

DALY-JUDGE—Lead-silver ore of high grade has recently been opened in a raise from 900-ft. level, and about 300 tons have been mined. The ore, which is carbonate, occurs along the contact of the upper limestone with shale. Previously this company's ore has been found along the limestone-quartzite contact below the 1600-ft. level.

WASHINGTON

Ferry County

NATIONAL COPPER—This company is considering the erection of a concentrating mill on its property near Enaville.

IVANHOE—Operations will be started at this property as soon as equipment can be delivered, and development work will be done. John E. Ryan, Oroville will have charge of the work.

Snohomish County

MAIDENS—The contract has been let for diamond drilling on this property.

DEL CAMPO METALS CO.—This company is installing some new machinery on its property. D. R. Keyes, Everett, has charge of the work.

Spokane County

RAMBLER CARIBOO—The mill at this mine is to be enlarged by the addition of crushers and tables in order to recover zinc. E. W. Zwicky, Spokane is manager.

Stevens County

COPPER CLIFF—Operations at this mine near Chewelah are to be resumed at once.

JOE DANDY—Some rich gold-silver-copper ore has been encountered at this property near Chewelah.

YOUNG AMERICA—Jacquish & Carlson, of Spokane, have taken a two-year lease on this group of claims at Bossburg, and operations will be extended at once.

BUTTE-CHEWELAH COPPER CO.—This company has been incorporated by G. B. Garrington, P. L. Eberhardt and V. A. Day, of Spokane, for the development of their copper property between Chewelah and Valley.

CANADA

Ontario

A GOLD PLACER DISCOVERY NEAR CARTIER, about 40 miles west of Sudbury, is reported. It is on the main line of the Canadian Pacific R.R. Considerable gold has been found in the Vermilion River, 20 miles east of Cartier in years past, but attempts to recover it on a working scale were not successful

COPPER MOUNTAIN MINING CO.—This company has been incorporated and will proceed with active work at once, on its property on the Illinois River, 40 miles from Grants Pass.

DOMINION MINERAL CO.—An option on the Worthington and Blezard mines at Sudbury has been granted to W. A. Edwards, of Toronto. The mines were formerly operated by this company.

DOMINION NICKEL CO.—This company controls the Hybinette process for refining nickel and will adopt it at the new treatment plant, which is being built near the Murray mine. The company is devoting its development chiefly to the Murray mine in which the ore is extensive, but low grade.

MOND NICKEL CO.—The three properties in the township of Levack, in the northwestern part of the nickel district owned by Tough, Stobie & McConnel, have been taken under option, and six drills are now at work. The same company also has an option on the Strathcona mine, which adjoins the Levack property. This was drilled by the Canadian Copper Co. last year and abandoned. The Mond company has had an option on the Levack properties before and did some drilling. There are no operating mines in this part of the district at present.

Ontario-Cobalt

PEOPLES MINE—This property, formerly known as the John Black, is to be re-opened.

HUDSON BAY—High-grade ore has been discovered on the 200-ft. level of this company's Gowganda property.

BELLELLEN—Shortly after resuming operations on this South Lorraine property, a shoot of high-grade ore was struck.

BUFFALO—The March report shows that the mill ran 634 hr. and treated 5374 tons of ore, having an average assay of 38 oz.; a total of 177,178 oz. was recovered. This is a slight decrease from the preceding month.

MILLER LAKE-O'BRIEN—This company has introduced an innovation in transportation in Northern Ontario, having purchased three auto-trucks to carry ore from the mine to Elk Lake, bringing in coal and other supplies on the return trip.

Ontario-Porcupine

SWASTIKA—The result of the first 26 days' run returned bullion to the value of $3500.

LUCKY CROSS—The mill is treating between 40 and 50 tons of ore per day. Five additional stamps will be installed.

MAIDENS-McDONALD—The diamond drill operating on this property has cut good ore at a depth of 680 feet.

FOSTER—It is understood that a deal is being negotiated for this Kirkland Lake property. A short time ago, $1,000,000 was offered but was refused.

DIXON—Electrical equipment including some of the 300-kw. transformers used by the Hollinger until replaced by 600-kw. machines, is being installed.

PEARL LAKE—Underground operations have been suspended due to shortage of power, but the company expects to have a steam plant running soon.

MONETA—Diamond drilling on the northern portion of the property has been completed. The results have not been made public, but are reported to have been satisfactory.

FOLEY O'BRIEN—This property has been taken over by the Sherrill Homestake Mining Co. Between 4000 and 5000 ft. of diamond drilling will be done to prove the ground.

REA—The leasing company operating this property has purchased the 5-stamp mill from the Little Pet mine, and it will be installed as soon as possible. The Rea has about 10,000 tons of ore above the 200-ft. level.

Yukon Territory

DAWSON ELECTRIC LIGHT & POWER CO.—Press dispatches state that the power house of this company was burned to the ground May 3, the loss being estimated at $200,000. The mining companies that depended upon the company for power were obliged to stop work. Temporary electric service was reëstablished May 4.

MEXICO

Chihuahua

SAN TOY MINING CO.—While mining operations have continued without interruption railroad service between Chihuahua and Torreon has been so irregular that only 12 cars of ore have been shipped to Torreon since Jan. 1, and the smeltery at Torreon is now shut down for lack of fuel. The funds available for the dividend just declared have been realized from the sale of a part of the accumulations of ore mined during the last four months to the Chihuahua plant of the American Smelting & Refining Co. During April, 1000 tons of ore was taken by that plant and shipments are continuing at the rate of 50 tons per day.

Sonora

GREENE-CANANEA—It is reported that four blast and one reverberatory furnaces are in operation; about $1,000,000 worth of copper is in transit. At a recently held meeting it was decided to pass the dividend notwithstanding the fact that sufficient funds for the usual quarterly dividend were in the treasury. No announcements can be made as to when normal conditions will be reëstablished.

SOUTH AMERICA

Colombia

PLATINUM OPERATIONS are being begun by an English company on the Condoto, San Juan and other rivers in the Choco district.

THE NEW LAW REGARDING THE OPERATION OF EMERALD MINES under private ownership, makes a substitution of 10% of the gross value of the product in lieu of the payment of $60,000. The gross product of the mines, however, has to be delivered to the government, which sells it for the producer, in Europe and afterward deducts the 10% royalty. Plans to organize a company to exploit some emerald properties near Muzo are being made in Medellin.

Department of Antioquia

ON THE PORCE RIVER, not far from Medellin, several hydraulic elevators are in use and with few exceptions, the properties have paid well.

THE SAN BARTOLOME RIVER, which empties into the Magdalena just below Puerto Berrio, the headwaters of which are near the divide of the Porce River, is being examined with a view of equipping some of the gravel deposits with hydraulic plants and others with dredges.

LA UNION—A cyanide plant is being built at this mine near Manizales.

VOLCANES—This mine, near La Cascada, has been paying dividends for several months.

LA CLARA—Monthly production of this mine near Amalfi is $8000; operating expenses amount to $3000. There are 10 stamps in the mill.

LA CLARA—This mine, on the Porce River, is being operated by McGuire Bros., who have taken out 125 lb. of gold, in the last three months.

FRONTINO & BOLIVIA—These mines at Remedios, worked for nearly a century, but with varying success, are being operated by an English company, and are paying dividends. The laborers are on strike because of a reduction in wages.

LA CASCADA—This mine near Manizales has been paying dividends for more than one year. The production for March was worth $17,000, of which $1800 was recovered by cyanide treatment. New veins are being opened and the equipment is to be enlarged.

LA CONSTANCIA—A cyanide plant is being built at this mine near Anori, which has a record of $1,000,000 production under native ownership. Because of the depth which the workings attained the work was abandoned until a new company acquired the property.

ZANCUDO—These mines near Medellin, which have been in operation for more than 100 years, are still paying well. The production in March was $26,000, of which $7000 was paid in dividends and a considerable amount charged to the reserve account. This is the best equipped quartz mine in the country.

AFRICA

Rhodesia

GOLD PRODUCTION IN RHODESIA IN MARCH was 61,274 oz., the largest monthly production ever reported. For the quarter ended Mar. 31, the totals were 151,912 oz. in 1912 and 163,325 oz. in 1913; an increase of 11,413 oz. this year. Other mineral production for the quarter was: Silver, 34,730 oz., a decrease of 6664 oz.; lead, 58 tons, a decrease of 81 tons; wolframite, 4 tons; chrome ore, 13,230 tons, an increase of 1397 tons; coal, 57,769 tons, an increase of 3148 tons. Diamonds reported were 137 carats.

ASIA

Chosen

ORIENTAL CONSOLIDATED—The cleanup for April was $167,630.

AUSTRALIA

New South Wales

GREAT COBAR—This smeltery, producing about 15,000,000 lb. of copper annually, was to be closed May 5, for three or four weeks because of lack of coke.

THE MARKET REPORT

METAL MARKETS

NEW YORK—May 7

The metal markets have been more active. More business has been apparent in copper. In some lines prices have tended a little downward, but changes have not been great.

Copper, Tin Lead and Zinc

Copper—The market remained in its previous dormant state until the first of the week. The clearing of the political outlook in Europe, which was announced on Monday, was immediately reflected in the attitude of foreign buyers, who had held back for some time for fear of the complications which might arise out of the Montenegrin situation. Large orders were placed for export and the activity was further stimulated by reports that the statistics of the Producers' Association to be published tomorrow would make a very favorable showing. Domestic consumers have so far held aloof, but it is expected that they will enter the market at an early date. The close is firm at 15⅝@15¾c. for Lake copper, and 15.35@15.45c. for electrolytic copper in cakes, wirebars and ingots. Casting copper is quoted at 15.15@15.20c. as an average for the week.

The standard market advanced under covering of the bear accounts, which were put out in previous weeks, and the close is cabled firm at £69 7s. 6d. for spot, and £69 5s. for three months.

Base price of copper sheets is 21@22c. per lb. Full extras are charged, and higher prices for small quantities. Copper wire is 16½c. carload lots at mill.

Copper exports from New York for the week were 9022 long tons. Our special correspondent gives the exports from Baltimore at 4684 tons for the week.

Visible stocks of copper in Europe on Apr. 30 are reported as follows: Great Britain 21,760; France, 3220; Rotterdam, 6200; Hamburg, 4920; Bremen, 2270; total, 38,370 long tons, or 85,948,800 lb. This is a decrease of 550 tons from March 31. In addition 2050 tons are reported afloat from Chile and 3400 afloat from Australia; making a total on April 30 of 43,820 tons.

Tin—The market remained very firm, supported by the good statistics published at the beginning of this month. The latter part of last week there was a considerable squeeze of spot tin in the London market, which resulted in advancing this position about £12 over three months' tin. Commencing with this week, this backwardation was gradually reduced, so that it has now reached about £7. Very little interest was shown on part of domestic consumers, and due to this, and also because of quite an accumulation of tin in this port, spot and near-by tin were freely offered at about 1c. per lb. below importation prices, without, however, finding takers. A change in this situation took place on May 6 when quite a little business was transacted on the New York Metal Exchange for spot and June deliveries at about only ⅜c. per lb. under importation prices. The market closes firm at £231 for spot and £223 10s. for three months, and about 50½c. in New York.

Shipments of tin from the Straits two months ended Feb. 28 were: United States, 4381; Great Britain, 4979; other Europe, 1238; India and China, 221; total 10,819 long tons, an increase of 1280 tons over last year.

Lead—To everybody's surprise the American Smelting & Refining Co. reduced its price on Monday, May 5, to 4.35c. New York, the figure which ruled prior to the recent advance. It is assumed in the trade that they were prompted in making a reduction through the action of outside sellers, particularly second hands, who had accumulated lead at lower prices and were offering it for sale at a considerable discount after the market had been advanced. The sudden and unexpected change has rather unsettled sentiment, and the close is barely steady at 4.20@4.25c. St. Louis, and 4.30@4.35c. New York.

The London market has shown decided strength throughout the week, and the close is firm at £18 7s. 6d. for Spanish lead, and 7s. 6d. higher for English.

Spelter—The market has been practically lifeless. In spite of the severe decline, consumers do not appear willing to take hold, and it is assumed that this is largely due to the pending tariff legislation. For the same reason, smelters continue anxious to market their output, and the consequence is a further decline. The close is easy at 5.25@5.35c. St. Louis, and 5.40@5.50c. New York.

The London market is unchanged at £25 10s. for good ordinaries and £25 17s. 6d. for specials.

Base price of zinc sheets is now $7.75 per 100 f.o.b. La Salle-Peru, Ill., less 8% discount.

Other Metals

Aluminum—The market is still rather quiet, and deliveries have been largely on contract. Prices are a shade easier, 26½@27c. per lb. being asked for No. 1 ingots, New York.

The "Echo des Mines" reports that the late and cold spring in Europe has interfered with the production of aluminum. The works in the valley of the Arc in France and the Neuhausen works in Switzerland are behind in their contract deliveries, having been short of power, owing to the late melting of the snow in the lower Alps.

DAILY PRICES OF METALS

NEW YORK

May	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
1	4.8670	60	15⅝ @15⅝	15.20 @15.30	50	4.45 @4.50	4.30 @4.35	5 45 @5.50	5.30 @5.35
2	4.8670	60⅛	15⅝ @15⅝	15.20 @15.30	49⅜	4.45 @4.50	4.30 @4.35	5.45 @5.50	5.30 @5.35
3	4.8665	60¼	15⅝ @15⅝	15.20 @15.30	49½	4.45 @4.50	4.30 @4.35	5.40 @5.50	5.25 @5.35
5	4.8660	60	15⅝ @15⅝	15.25 @15.35	49⅜	4.30 @4.35	4.20 @4.25	5 40 @5.50	5.25 @5.35
6	4.8660	60	15⅝ @15⅝	15.30 @15.40	50⅛	4.30 @4.35	4.20 @4.25	5.40 @5.50	5.25 @5.35
7	4.8650	60⅛	15⅝ @15¾	15.35 @15.45	50½	4.30 @4.35	4.20 @4.25	5.40 @5.50	5.25 @5.35

The quotations herein given are our appraisal of the market for copper, lead spelter and tin based on wholesale contracts with consumers without distinction as to deliveries; and represent, to the best of our judgement, the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic. We quote casting copper at 0.15c. below the price for electrolytic. The quotations for lead represent wholesale transactions in open market for good ordinary brands, both desilverized and non-desilverized; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

May	Silver	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
		Spot	3 Mos	Best Sel'td	Spot	3 Mos		
1	27 11/16	67⅞	67⅞	73½	232	220	17⅜	25½
2	27 11/16	68 5/16	68 5/16	74½	230	220½	17⅜	25½
3	27¾	....	....	....	....	....	....	....
5	27⅝	69¼	69	75	230½	222	18¼	25½
6	27⅝	69¼	69⅜	75	230	223	18 7/16	25½
7	27 11/16	69⅜	69¼	75	231	223½	18⅜	25½

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, pot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c.; = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 21¾c.

Antimony—Business has been rather dull, buyers being inclined to hold back until the tariff is settled. Quotations are lower. Cookson's is 8.80@9c. per lb.; Hallett's, 8.25@8.50c., while 7.70@7.90c. is asked for Chinese, Hungarian and other outside brands.

Quicksilver—The market is still rather quiet with prices unchanged. New York price is $39 per flask of 7ᵥ lb., with 58c. per lb. for small lots. San Francisco, $38.50 for domestic orders and $36 for export. The London price is £7 10s. per flask, with £7 2s. 6d. named from second hands.

Bismuth—The syndicate which controls the European production quotes 7s. 6d.—equal to $1.80—per lb. in London. In New York a quotation of $1.72 per lb. is made for metal produced from American ores.

Magnesium—The price of pure metal is $1.50 per lb. for 100-lb. lots, f.o.b. New York.

Nickel—Shot, block and plaquettes are quoted at 40@45c. per lb., according to quality and size of order. Electrolytic nickel is 5c. per lb. higher.

Gold, Silver and Platinum

Gold—The price of gold on the open market in London was unchanged at 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. Most of the supplies received went to the Bank of England.

Exports of gold from New York, week ended May 3, were $237,171; imports were $410,477, mainly from Mexico and South America. May 6 gold to the amount of $2,000,000 was taken in New York for shipment to Paris.

Gold in the United States, May 1, is estimated by the Treasury Department as follows: Held against gold certificates outstanding, $1,075,198,169; in Treasury, $180,183,139; in banks and circulation, $611,705,977; total, $1,867,087,085, an increase of $8,517,191 during April.

Platinum—Business is good and the market is steady and unchanged. Dealers ask $45@46 per oz. for refined platinum, according to size of order. Hard metal—platinum-iridium alloy—is $49@53 per oz., according to proportion of iridium.

Our Russian correspondent writes, under date of April 24, that the market is very strong; no decline is expected. From Ekaterinburg it is reported that a considerable development of the platinum industry in the Ural region this year is expected. The prospecting works are being carried out on a large scale, especially by the great companies and new investments are being made. The prices remain generally unchanged. The quotations are at Ekaterinburg 9.70 rubles per zolotnik; in St. Petersburg, 37,700@37,900 rubles per pood, for crude metal, 83% platinum. These prices are equal to $36.47 and $40 per oz., respectively.

Silver—The market has ruled quiet and steady the past week, the chief factor for strength being buying for China. It closes steady at 27⅛d. in London.

Exports of silver from London to the East, Jan. 1 to Apr. 24, reported by Messrs. Pixley & Abell:

	1912	1913	Changes
India	£2,245,800	£2,501,300	I. £255,500
China	630,000	166,000	D. 464,000
Total	£2,875,800	£2,667,300	D. £208,500

Coined silver in the United States, May 1, is reported by the Treasury Department as follows: Standard dollars, $565,569,020; subsidiary coins, $175,087,365; total, $740,656,385. Of the dollars, $480,597,000 are held in the treasury against silver certificates outstanding.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—May 3

The base price of 60% zinc ore remained unchanged at $40@44 per ton. The base price paid for 80% lead ore was $53@54 per ton. Improved wagon roads caused some of the surplus stocks to move, although a few companies are holding for advanced prices; a number of the lower grade producers are closed down.

SHIPMENTS WEEK ENDED MAY 3

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	3,617,510	455,030	1,371,940
Year to date	49,320,730	2,510,930	21,871,510

Shipped during week to separating plants, 2,692,070 lb. zinc ore.

JOPLIN, MO.—May 3

The high price of zinc blende continues at $47 and the base range of 60% zinc at $42@44 per ton, the fore-week cut of $1 being restored at the week-end. Calamine sold at $20@22 per ton of 40% zinc, and was in more demand. The average of all grades of zinc is $40.94 per ton. Lead is unchanged at $53@53.50 per ton of 80% metal contents, and the average of all grades is $52.66 per ton.

SHIPMENTS WEEK ENDED MAY 3

	Blende	Calamine	Lead ore	Value
Totals this week..	11,713,530	820,510	1,832,420	$304,937
Totals 18 weeks...	193,859,390	13,237,840	33,518,570	$5,596,955

Blende value, the week, $246,724; 18 weeks, $4,531,334.
Calamine value, the week, $9952; 18 weeks, $180,740.
Lead value, the week, $48,262; 18 weeks, $884,881.

OTHER ORES

Manganese Ore—The latest quotations for manganese ore in Great Britain are: Indian or Brazilian 50% manganese, 24@24½c. per unit; 48%, 23½@24c. Russian, 50% ore, 19½@20c.; 48%, 19@19½c. per unit. Prices are for ore c.i.f. British port.

IRON TRADE REVIEW

NEW YORK—May 7

The iron markets have not been especially active, though work at the mills is abundant, and specifications are reported coming in at a good rate. New business is slow.

The Standard Oil people have placed a further order for Welsh tinplate. It is claimed that they cannot get the deliveries they want here.

Exports and Imports of Iron and Steel and of manufactures thereof in the United States two months ended Feb. 28 are valued by the Department of Commerce and Labor as below:

	1912	1913	Changes
Exports	$38,902,781	$49,227,280	I. $10,324,499
Imports	4,291,428	5,441,889	I. 1,150,461
Excess, exports	$34,611,353	$43,785,391	I. $9,174,038

Exports of mining machinery for the two months were valued at $420,773 in 1912, and $902,410 in 1913; an increase of $481,637 this year.

PITTSBURGH—May 6

Operations at steel mills continue at full capacity, despite the market dullness, but in some lines the specifications on hand are sufficient to continue full operations for but a short time. The line likely to play out first is wire, steel pipe coming second.

A feature newly disclosed is that in the lines in which there is the largest volume of specifications on books, bars, plates and shapes, a large portion of the specifications is dated so that material cannot be shipped ahead of time, and on account of decreased pressure from some buyers the mills are able to schedule fresh specifications for early dates, whereby they can make much quicker deliveries in these lines than could be arranged a month or two ago. This has resulted in a practically complete disappearance of premiums for early deliveries.

Prices of finished-steel products are firm all along the line, except for the shading in galvanized sheets already reported. The firmness is remarkable in view of the fact that in some lines the mills have so little business ahead.

The whole trade, covering coke, pig iron and unfinished steel, as well as finished steel, is extremely dull, bordering on stagnation, as regards new business, while as to filling of contract business there is a full movement of coke, pig iron and unfinished steel, and specifications against finishing steel contracts averaging perhaps 75% of the shipments.

Pig Iron—At least one sale of foundry pig iron has been made below $15, Valley, although this remains the figure generally quoted. The Westinghouse Electric & Manufacturing Co. has inquired for pig iron to meet its requirements over the second half of the year, probably about 15,000 tons, action to be taken next week, and if the purchase is made, it will go far toward establishing a market, and may even give prices an upward trend as some smaller buyers frequently follow the lead of this interest. A steel plant is negotiating for 50,000 to 75,000 tons of bessemer iron over the second half, to follow a contract now in force and expiring next month, but it is doubtful whether any purchase will be made. Basic iron is altogether stagnant. W. P. Snyder & Co. announce their pig-iron averages for April, compiled by averaging the actual sales, at $17,008, Valley, for bessemer and $15,714, Valley, for basic. This bessemer average shows a decline of 24.2c. the first decline on this movement, while basic shows a decrease of 34.5s., the total decline, from a high point in December, being 73.5c. We quote as follows, the bessemer price being largely nominal, the basic price purely nominal and the foundry price subject to probable shading: Bessemer, $17; basic, $15.75; No. 2 foundry, $15; malleable, $15.25; forge,

$14.50, all f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh. McKeefrey furnace at Leetonia will blow in this month.

Coke—The market is almost stagnant, but the supply of really good coke is quite limited and hence prices are fairly well maintained at $2@2.25 for prompt furnace and at $2.90@3.25 for prompt foundry. Operators state they want $2.50 on contracts for furnace coke for second half, but this is clearly far beyond the ideas of furnacemen, and the latter will not buy in any event until they see how the pig-iron market will turn out.

Ferromanganese—The market remains stagnant and quotable at $61, Baltimore, freight to Pittsburgh being $2 per ton.

Steel—Buyers have not taken hold since steel became freely available for third quarter. Prices are regarded as high still, despite the decline. We quote prompt billets at $28.50, and prompt sheet bars at $29, third-quarter billets being $27 and third-quarter sheet bars $27.50, f.o.b. maker's mill, Pittsburgh or Youngstown.

IRON ORE

Imports of iron ore into the United States two months ended Feb. 28 were: From Cuba, 256,970; Sweden, 47,091; Spain, 35,896; Newfoundland, 15,418; other countries, 11,005; total, 364,197 long tons, an increase of 80,386 tons over last year.

Exports of iron ore for the two months were 23,937 tons in 1912, and 20,247 in 1913; decrease, 3690 tons.

Imports of manganese ore for the two months were 35,348 tons in 1912, and 97,096 in 1913; increase, 61,748 tons.

COKE

Coke production in the Connellsville region is now over 400,000 tons weekly and transportation is good. Prices are well maintained.

Exports and Imports of Fuel in the United States, two months ended Feb. 28, were, in long tons:

	Exports		Imports	
	1912	1913	1912	1913
Anthracite	453,322	665,066	25	6
Bituminous	1,313,134	1,872,753	243,709	260,564
Coke	112,680	155,651	14,103	10,701
Steamer coal	1,083,412	1,176,911	.....	.....
Total	2,962,548	3,870,381	257,837	271,271

The bunker coal, or coal furnished to steamships in foreign trade, is practically all bituminous. The heaviest exports are to Canada, while that country also furnishes a large share of the imports. The imports are mainly on the Pacific Coast.

CHEMICALS

NEW YORK—May 7

The general markets continue in fair shape with rather steady buying evident.

Arsenic—Business is still quite dull. Supplies from Mexico are falling off. Prices are a little easier at $3.75@$4 per 100 lb. in carload lots.

Copper Sulphate—Business is steady with sales at a fair rate. Quotations are unchanged at $5.25 per 100 lb. for carload lots and $5.50 per 100 for smaller parcels.

Nitrate of Soda—Business has been quiet, with comparatively little doing. Quotations are unchanged at 2.60c. per lb. for spot, 2.57½c. for May, 2.55c. for June, 2.50c. for July and August and 2.47½c. for later deliveries.

Imports and Exports of Chemicals and raw materials in the United States, two months ended Feb. 28, were as follows:

	Imports		Exports	
	1912	1913	1912	1913
Arsenic, lb.	768,666	1,762,450	.....	.....
Copper sulphate, lb.	.....	.....	1,869,224	2,068,469
Bleach, lb.	16,812,067	11,969,115	.....	.....
Potash salts, lb.	130,740,101	131,208,940	78,008	2,153,521
Soda salts, lb.	2,018,820	2,757,831	95,747	45,807
Acetate of lime, lb.	.....	.....	8,923,891	13,013,468
Nitrate of soda, tons	80,052	84,660	1,279	641
Sulphate of ammonia, lb.	33,314,839	33,439,286	.....	.....
Phosphates, tons	.....	.....	136,906	140,857
Sulphur, tons	3,483	1,899	2,183	6,760
Pyrites, tons	126,516	185,222	.....	.....
Magnesite, lb.	16,708,340	58,633,190	149,440	767,950
Chrome ore, tons	9,249	13,879	.....	.....

Exports include reëxports of foreign material. Some phosphate rock is imported, but is not given separately in the trade returns.

PETROLEUM

The monthly statement of the "Oil City Derrick" shows new wells completed in April as follows: Pennsylvania grade, 642; Lima-Indiana, 57; Kentucky, 21; Lllinois, 105; Kansas-Oklahoma, 763; Texas-Louisiana, 205. A grand total of 1793 wells was completed, the largest number ever reported for these divisions. The increase over the March figures is 317. New production aggregates 60,558, a decline of 9471 bbl. from the previous month. There were 23 more dry holes and 27 more gas wells than in March. The increase in completions comes from each division with the exception of Lima and Indiana. Pennsylvania and Oklahoma show the greatest increase. Work under way on April 30 showed a grand total of 2725, made up of 816 rigs and 1909 wells drilling.

COPPER SMELTERS' REPORTS

This table is compiled from reports received from the respective companies, except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept. of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield ther is reckoned at 97%. In computing the total American supply duplications are excluded.

	Jan.	Feb.	March	April
Alaska shipments	1,668,328	660,250	472,293	.....
Anaconda	21,000,000	21,250,000	22,900,000	23,800,000
Arizona, Ltd.	3,100,000	3,000,000	3,200,000	.....
Copper Queen	7,554,966	6,810,706	7,558,709	8,210,166
Calumet & Arizona	4,750,000	4,050,000	4,250,000	5,758,000
Chino	2,903,030	3,813,998	4,449,884	.....
Detroit	1,769,071	1,689,277	1,640,671	1,856,517
East Butte	1,469,000	1,325,000	1,400,000	.....
Mammoth	1,957,804	1,661,150	1,641,091	1,450,000
Giroux	650,000	600,000	.....	.....
Mason Valley	1,655,319	1,348,070	1,608,492	.....
Nevada Con.	4,169,705	4,798,537	5,555,320	.....
Ohio	492,760	380,849	596,651	.....
Old Dominion	2,727,000	2,381,000	2,853,000	.....
Ray	3,610,000	3,610,000	4,287,400	.....
Shannon	1,232,000	1,152,000	1,260,000	1,238,000
South Utah	*ni.*	*ni.*	.....	.....
United Verde*	2,900,000	2,750,000	.....	.....
Utah Copper Co.	7,182,495	7,585,303	8,248,880	.....
Lake Superior*	17,500,000	19,000,000	19,000,000	.....
Non-rep. mines*	7,500,000	7,000,000	8,000,000	.....
Total production	95,791,478	94,866,141	.....	.....
Imports, bars, etc.	34,026,236	21,372,292	.....	.....
Total blister	129,817,714	116,238,433	.....	.....
Imp. in ore and matte	7,563,758	9,459,432	.....	.....
Total American	137,381,472	125,697,865	.....	.....
Miami†	2,932,369	2,817,200	3,102,200	2,312,900
Shattuck-Arizona	1,381,422	1,136,480	1,234,450	.....
Brit. Col. Cos.:				
British Col. Copper	.....	.....	.....	.....
Granby	1,792,245	1,740,000	1,967,962	.....
Mexican Cos.:				
Boleo†	2,658,880	2,535,680	2,204,720	.....
Cananea	5,450,000	4,880,000	4,772,000	.....
Moctezuma	2,913,294	2,730,914	3,062,159	2,753,240
Other Foreign:				
Braden, Chile	1,484,000	1,178,000	1,472,000	.....
Cape Cop., S. Africa	770,540	.....	732,480	.....
Kyshtim, Russia	1,644,160	1,352,960	.....	.....
Spassky, Russia	974,400	1,003,520	.....	.....
Exports from				
Chile	6,752,000	5,824,000	7,840,000	.....
Australia	9,744,000	5,512,000	6,944,000	.....
Arrivals in Europe ‡	17,689,280	8,509,760	15,585,920	.....

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

‡ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
IV, '12.	125,464,644	69,513,846	53,252,326	62,367,557	136,819,200	199,186,757
V.	126,737,836	72,702,277	69,485,945	695,066,02	134,176,000	199,242,029
VI.	122,315,240	66,146,229	61,449,650	49,615,643	117,801,600	167,417,244
VII.	137,161,129	71,094,381	60,121,331	44,335,004	108,186,000	152,521,003
VIII.	145,628,521	78,722,418	70,485,150	50,280,421	113,299,200	163,579,621
IX.	140,089,819	63,460,810	60,264,796	46,701,374	113,568,000	160,269,374
X.	145,405,453	84,104,734	47,621,342	63,065,587	107,408,000	170,473,587
XI.	134,695,400	69,369,795	55,906,550	76,744,964	103,801,600	180,546,564
XII.	143,354,042	58,491,723	65,713,796	86,164,059	96,947,200	183,111,259
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
I, 1913.	143,479,625	65,210,030	60,383,845	105,312,582	78,491,840	183,904,422
II.	130,948,881	59,676,492	72,168,523	123,198,332	77,504,000	200,702,332
III.	136,251,849	76,585,471	77,699,306	122,302,890	81,244,800	203,547,690
IV.	.....	.....	.....	104,269,270	87,180,800	191,450,070
V.	.....	.....	.....	.....	85,948,800	.....

Note—From Jan. 1, 1913, visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq	Sale	Amt.
Algomah, Mich.	June 16	.....	$1.00
Atlas Wonder, Nev.	Apr. 21	May 14	0.01
Benton, Ida.	Apr. 20	May 20	0.0025
Best & Belcher, Nev.	May 20	June 10	0.05
Big Indian Copper, Utah.	May 13	June 4	0.018
Con. Imperial, Nev.	May 6	May 28	0.01
Con. Virginia, Nev.	Apr. 23	May 14	0.15
Deer Trail, Utah.	May 8	June 6	0.005
Eagle Mountain, Ida.	Apr. 19	May 17	0.0005
East Hercules Ext., Ida.	Apr. 15	.....	0.001½
Field Gold Copper, Utah.	May 13	June 4	0.015
Hale & Norcross, Nev.	May 5	May 26	0.05
Holy Terror, Ida.	Apr. 12	May 12	0.001
Jack Waite, Ida.	May 3	May 24	0.01
Knickerbocher, Ida.	Apr. 24	.....	0.005
Moonlight, Ida.	Apr. 19	May 22	0.005
North Lake, Mich.	May 19	.....	1.00
Sandstorm Kendall, Nev.	May 12	June 16	0.01
Santaquin Central, Utah.	Apr. 21	May 31	0.005
Tuscumbia, Ida.	Apr. 26	May 24	0.001
Union Con., Nev.	May 14	June 4	0.10
United Copper, Mont.	May 15	.....	0.30
Utah Centennial, Utah.	May 15	June 2	0.002
Wasatch, Utah.	Apr. 19	May 24	0.01

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	53.795	56.260	62.938	24.865	25.887	28.983
February	52.222	59.043	61.642	24.081	27.190	28.357
March	52.745	58.375	57.870	24.324	26.875	26.669
April	53.325	59.207	59.490	24.595	27.284	27.416
May	53.308	60.880	.....	24.583	28.038	.....
June	53.043	61.290	.....	24.486	28.215	.....
July	52.630	60.654	.....	24.286	27.919	.....
August	52.171	61.606	.....	24.082	28.375	.....
September	52.440	63.078	.....	24.209	29.088	.....
October	53.340	63.471	.....	24.594	29.299	.....
November	55.719	62.792	.....	25.649	29.012	.....
December	54.905	63.365	.....	25.349	29.320	.....
Year	53.304	60.835	.....	24.592	28.042	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York				London, Standard	
	Electrolytic		Lake			
	1912	1913	1912	1913	1912	1913
January	14.094	16.488	14.337	16.767	62.760	71.741
February	14.084	14.971	14.329	15.253	62.893	65.519
March	14.698	14.713	14.868	14.930	65.884	65.329
April	15.741	15.291	15.930	15.565	70.294	68.111
May	16.031	.....	16.245	.....	72.352	.....
June	17.234	.....	17.443	.....	78.259	.....
July	17.190	.....	17.353	.....	76.636	.....
August	17.498	.....	17.644	.....	78.670	.....
September	17.508	.....	17.698	.....	78.762	.....
October	17.314	.....	17.661	.....	76.389	.....
November	17.326	.....	17.617	.....	76.890	.....
December	17.376	.....	17.600	.....	75.516	.....
Year	16.341	.....	16.560	.....	72.942	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1912	1913	1912	1913
January	42.529	50.298	191.519	238.273
February	12.962	48.766	195.036	220.150
March	12.577	46.832	192.619	213.645
April	43.923	49.115	200.513	224.119
May	16.063	.....	208.830	.....
June	45.815	.....	205.863	.....
July	44.519	.....	202.446	.....
August	45.857	.....	208.351	.....
September	49.135	.....	223.762	.....
October	50.077	.....	228.353	.....
November	49.891	.....	227.619	.....
December	49.815	.....	226.875	.....
Av. year	46.096	.....	209.322	.....

New York in cents per pound; London in pounds sterling per long ton.

LEAD

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	4.435	4.321	4.327	4.171	15.597	17.114
February	4.026	4.325	3.946	4.175	15.738	16.550
March	4.073	4.327	4.046	4.177	15.997	15.977
April	4.200	4.381	4.118	4.242	16.331	17.597
May	4.194	.....	4.072	.....	16.509	.....
June	4.392	.....	4.321	.....	17.588	.....
July	4.720	.....	4.603	.....	18.544	.....
August	4.569	.....	4.452	.....	19.655	.....
September	5.048	.....	4.924	.....	22.292	.....
October	5.071	.....	4.894	.....	20.630	.....
November	4.615	.....	4.463	.....	18.193	.....
December	4.303	.....	4.152	.....	18.069	.....
Year	4.471	.....	4.360	.....	17.929	.....

New York and St. Louis cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	6.442	6.931	6.292	6.854	26.642	26.114
February	6.499	6.239	6.349	6.089	26.661	25.338
March	6.626	6.078	6.476	5.926	26.048	24.605
April	6.633	5.641	6.483	5.491	25.644	25.313
May	6.679	.....	6.529	.....	25.790	.....
June	6.877	.....	6.727	.....	25.763	.....
July	7.116	.....	6.966	.....	26.174	.....
August	7.028	.....	6.878	.....	26.443	.....
September	7.454	.....	7.313	.....	27.048	.....
October	7.426	.....	7.276	.....	27.543	.....
November	7.371	.....	7.221	.....	26.804	.....
December	7.162	.....	7.081	.....	26.494	.....
Year	6.943	.....	6.799	.....	26.421	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON IN PITTSBURG

Month	Bessemer		Basic		No. 2 Foundry	
	1912	1913	1912	1913	1912	1913
January	$15.12	$18.15	$13.32	$17.35	$14.00	$18.59
February	15.03	18.15	13.28	17.22	14.01	18.13
March	14.95	18.15	13.66	16.96	14.10	17.53
April	15.13	17.90	13.90	16.71	14.15	16.40
May	15.14	.....	13.90	.....	14.12	.....
June	15.15	.....	14.11	.....	14.22	.....
July	15.15	.....	14.38	.....	14.38	.....
August	15.43	.....	14.90	.....	14.85	.....
September	16.86	.....	16.03	.....	15.63	.....
October	17.90	.....	17.18	.....	17.22	.....
November	18.07	.....	17.09	.....	18.00	.....
December	18.15	.....	17.45	.....	18.73	.....
Year	$16.01	.....	$14.93	.....	$15.28	.....

STOCK QUOTATIONS

COLO. SPRINGS May 6

Name of Comp.	Bid.
Acacia	.02⅝
Cripple Cr'k Con.	.01
C. K. & N.	.14
Doctor Jack Pot.	.07½
Elkton Con.	.58½
El Paso	3.90
Findlay	.03½
Gold Dollar	.10
Gold Sovereign	.02½
Isabella	.12
Jack Pot	.05⅝
Jennie Sample	‡.03½
Lexington	‡ 008
Moon Anchor	.01
Old Gold	.02⅝
Mary McKinney.	.59½
Pharmacist	.01½
Portland	.95
Vindicator	.93
Work	‡.004

SALT LAKE May 6

Name of Comp.	Bid.
Beck Tunnel	.08
Black Jack	.11
Cedar Talisman	.03
Colorado Mining	.14
Columbus Con.	.12
Crown Point	.02⅜
Daly-Judge	6.25
Grand Central	.65
Iron Blossom	1.37½
Little Bell	‡.35
Lower Mammoth	.02⅜
Mason Valley	6.25
May Day	.09
Nevada Hills	.87
New York	‡ 03
Prince Con	47
Silver King Coal'n	3.75
Sioux Con	.02½
Uncle Sam	.05
Yankee	.07½

TORONTO May 6

Name of Comp.	Bid	Name of Comp.	Bid
Bailey	.09	Foley O'Brien	.26
Coniagas	.07⅜	Hollinger	17.25
T. & Hudson Bay.	‡64.00	Imperial	.03
Timiskaming	.33	Jupiter	.49
Wettlaufer-Lor.	.14	Pearl Lake	.49
Apex	‡.02½	Porcu. Gold	.18
Crown Chartered.	.00⅜	Preston E. D.	‡.04
Dobie	‡ 15	Rea	.25
Dome	‡17.50	Swastika	.06½
Dome Exten.	.08	West Dome	‡.34½

SAN FRANCISCO May 6

Name of Comp.	Clg.	Name of Comp.	Bid
COMSTOCK STOCKS		MISC. NEV. & CAL.	
Alta	.07	Belmont	6.20
Belcher	.20	Jim Butler	.90
Best & Belcher	.01	MacNamara	.19
Caledonia	1.00	Midway	.52
Challenge Con.	‡.05	Mont.-Tonopah	1.60
Chollar	.20	North Star	.65
Confidence	.33	West End Con.	1.42½
Con. Virginia	.17	Atlanta	.13
Crown Point	.24	Booth	.02
Gould & Curry	.02	C.O.D. Con.	.04
Hale & Norcross	.06	Comb. Frac.	.04
Mexican	.79	Jumbo Extension	.22
Occidental	.70	Pitts.-Silver Peak	.50
Ophir	.20	Silver Pick	.05
Overman	.27	St. Ives	.30
Potosi	.02	Tramp Con.	‡.01
Savage	.02	Argonaut	1.55
Sierra Nevada	.24	Bunker Hill	1.50
Union Con.	.07	Central Eureka	.17
Yellow Jacket	.24	So. Eureka	2.10

N. Y. EXCH. May 6

Name of Comp.	Clg.
Amalgamated	73¾
Am. Agri. Chem.	49
Am.Sm.&Ref.,com	66¼
Am. Sm. & Ref., pf.	102
Am. Sm. Sec., pf. B	83½
Anaconda	37¾
Batopilas Min.	1
BethlehemSteelpf	70
Chino	38⅝
FederalM. & S., pf.	35
Goldfield Con.	2
GreatNor.,ore,ctf.	23¼
Guggen. Exp.	46
Homestake	100
Inspiration Con.	16⅝
Miami Copper	23
Nat'nalLead,com.	48
National Lead, pf.	106
Nev. Consol.	16⅞
Phelps Dodge	200
Pittsburg Coal, pf.	83
Ray Con.	18
RepublicI&S,com.	24
Republic I & S, pf.	82¾
SlossSheffi'd,com.	30⅜
Sloss Sheffield, pf.	88
Tennessee Copper	34¼
Utah Copper	50½
U. S. Steel, com.	59½
U. S. Steel, pf.	106⅜
Va.Car. Chem., pf.	101

N. Y. CURB May 6

Name of Comp.	Clg.
Barnes King	‡1.35
Beaver Con.	.35
Braden Copper	7¾
B. C. Copper	3
Buffalo Mines	2¼
Caledonia	‡.40
Con. Ariz. Sm.	⅝
Davis-Daly	2½
Diam'field-Daisy	.04
Ely Con.	.08
Florence	.39
Giroux	2⅜
Gold Hill Con.	‡¼
Greene Cananea.	6¾
Greenwater	.05
Internat. S. & R.	‡117
Kerr Lake	3¼
Keystone	‡2
La Rose	2⅜
McKinley-Dar-Sa.	1⅛
Min. Co. of A. new	2½
Motherlode Gold.	‡.60
Nev. Utah M. & S.	‡.01
Nipissing Mines.	8⅞
Ohio Copper	⅞
Pacific Sm. & M.	⅜
Puebla S. & R.	2
South Live Oak	‡2
South Utah M. & S.	⅛
Standard Oil (Old)	‡1030
Stand'd Oil of N.J.	350
Stewart	1⅛
Tonopah	5⅜
Tonopah Ex.	2⅝
Tonopah Merger.	1
Tri-Bullion	¼
Tularosa	⅛
Union Mines	⅛
United Cop., pfd.	‡3½
Yukon Gold	2⅝

LONDON May 6

Name of Com.	Clg.
Camp Bird	£0 17 8d
El Oro	0 14 0
Esperanza	1 4 8
Mexico Mines	5 15 2
Oriental Con.	1 8 4
Oroville	0 5 8
Santa Gert'dis	1 4 8
Tomboy	1 1 7

BOSTON EXCH. May 6

Name of Comp.	Clg.
Adventure	1½
Ahmeek	295
Algomah	⅜
Allouez	32½
Am. Zinc	25
Ariz. Com., ctfs.	3¼
Bonanza	.37
Boston & Corbin	3
Butte & Balak	2
Calumet & Ariz	63½
Calumet & Hecla	451
Centennial	14
Cliff	‡2
Copper Range	42½
Daly West	2¾
East Butte	12
Franklin	6
Granby	63
Hancock	18½
Hedley Gold	32
Helvetia	¼
Indiana	9
Island Cr'k, com.	48⅛
Island Cr'k, pfd.	82
Isle Royale	23
Keweenaw	1¾
Lake	12¼
La Salle	4
Mass	3½
Michigan	1¼
Mohawk	50
New Arcadian	1½
New Idria Quick.	3⅞
North Butte	28¾
North Lake	1
Ojibway	1
Old Dominion	47
Osceola	83
Quincy	65½
Shannon	9⅞
Shattuck-Ariz.	24¼
Superior	28
Superior & Bost.	3¼
Tamarack	88
Trinity	3¾
Tuolumne	2 1/16
U. S. Smelting	40
U. S. Smelt'g, pf.	47
Utah Apex	1⅛
Utah Con.	7¾
Victoria	1
Winona	1⅝
Wolverine	48¼
Wyandot	.90

BOSTON CURB May 6

Name of Comp.	Last
Alaska Gold M.	11
Bingham Mines	2½
Boston Ely	.45
Boswyocolo	‡.01
Butte Central	2 7/16
Cactus	.08
Calaveras	2½
Chief Cons	1 1/16
Corbin	.85
Cortez	.20
Crown Reserve	3½
Eagle & Blue Bell.	.96
First Nat. Cop.	1⅞
Majestic	40
Mexican Metals	1
Moneta Porc.	‡.06
Nevada-Douglas	1½
New Baltic	.90
Oneco	.99
Raven Copper	.15
Rhode Island Coal	.07
Smokey Dev.	1½
S. W. Miami	2½
South Lake	6½
Trethewey	‡.36
United Verde Ext.	.72

‡Last quotation.